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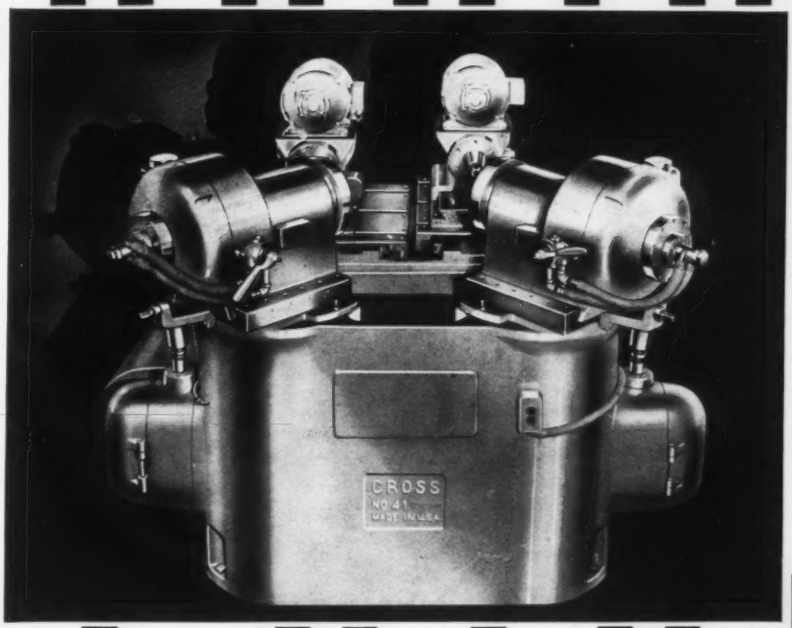
MACHINE DESIGN



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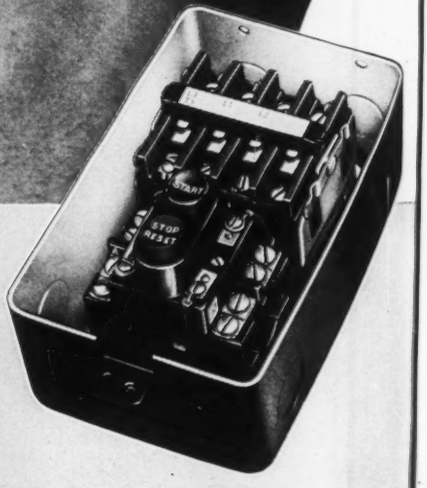
CUTLER-HAMMER
MOTOR CONTROL
C-H



Standard Features of C-H Bulletin 9586, Size "0" Pushbutton Magnetic Motor Control

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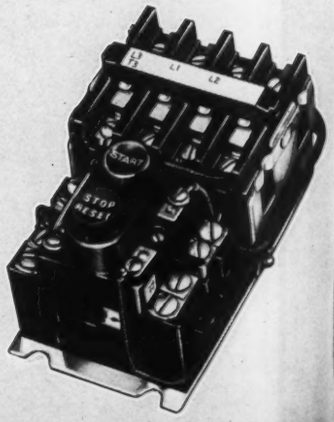
Dust between contacts causes heating and burning. *But dust can't settle on Vertical Contacts!* C-H Contacts are *always* vertical, hence *out* in the open, *air-cooled,* fully accessible.



MACHINE DESIGN

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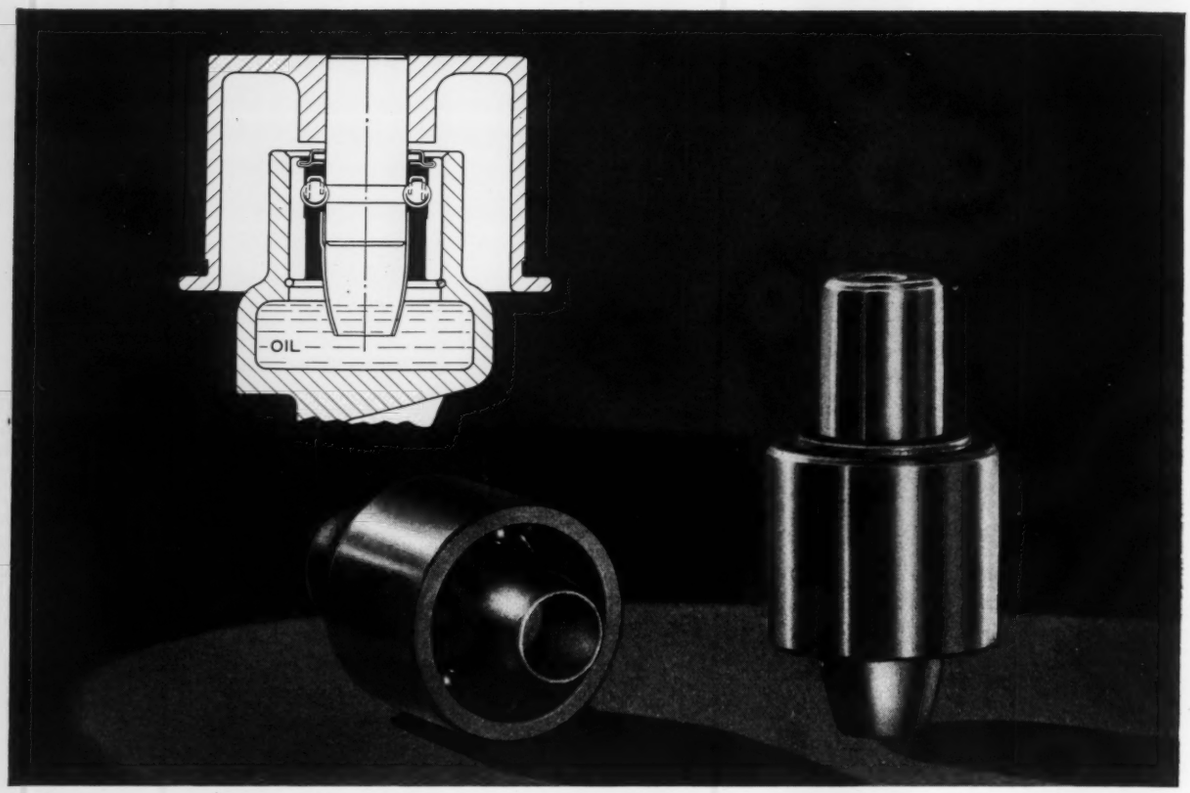
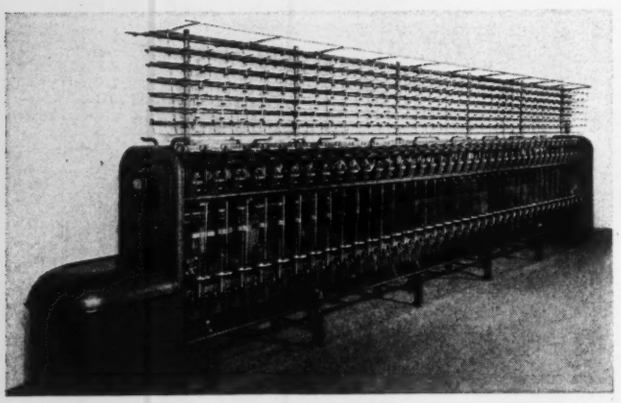
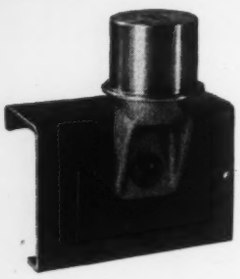


New Bearing Has Own Oiling System



↑ **New Atwood 5 B** machine designed for greater efficiency, speed and economy of doubling and twisting Silk and Rayon yarns. Is equipped with New Departure Vertical Tension Pulley Bearings.



Atwood Tension Pulley showing modern, clean cut simplicity of mounting. →

THIS "new departure" by New Departure is a Vertical Tension Pulley bearing now being used in some of the latest Textile Machines.

Unique in design, this bearing not only provides a vertical stub shaft for the pulley, but contains its own oil circulating system for speeds of 3500 to 15,000 r.p.m. By this carefully developed system a fine spray or mist is continually directed at the balls and races.

Being enclosed with friction-free all-metal seal, this New Departure protects its oil reservoir from dirt or lint and does not require relubrication oftener than once every two years. It requires no locknuts, screws or other parts for mounting and may be removed instantly for re-oiling and as quickly replaced.

New Departure, Division of General Motors, Bristol, Conn.

NEW DEPARTURE

THE FORGED STEEL BEARING

2889

Balancing Cutting Torque in Coal Drill

By Samuel Leven
Joy Mfg. Co.

BALANCING of torque is rarely more important than in portable machines, where rigidity in the ordinary sense is impossible. This fact is aptly demonstrated in the coal drill developed by Joy Mfg. Co., shown in *Figs.* 1 and 2. By utilizing two oppositely rotating cutting members, a different prin-

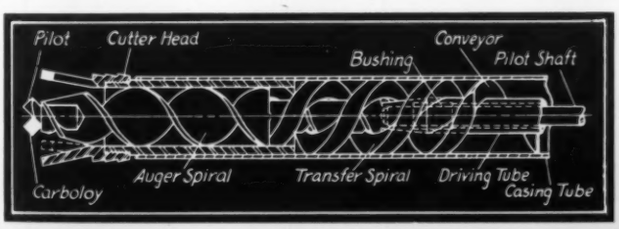
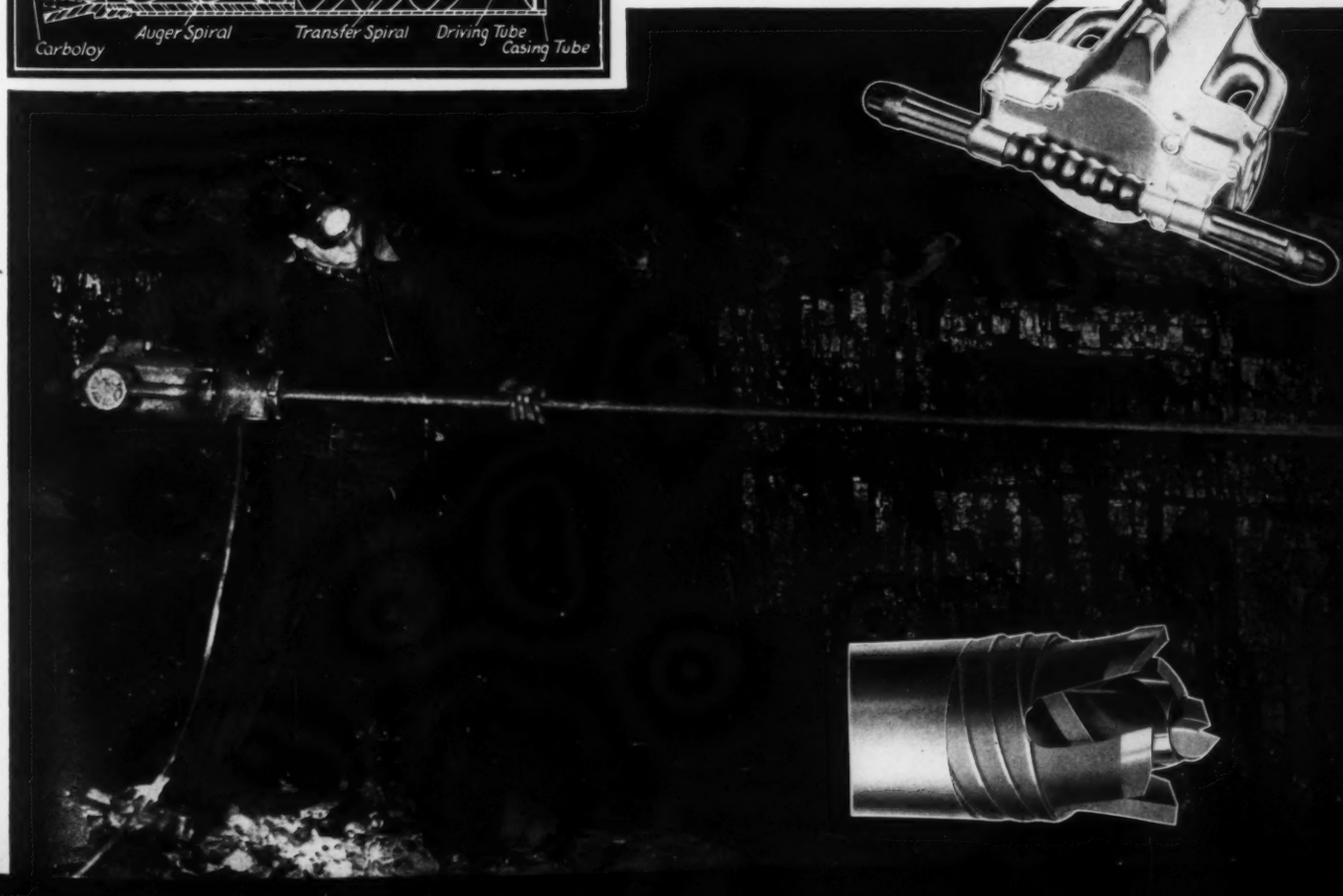


Fig. 1—Left—Principle of drilling is clearly shown here. Outer tube terminates in cutterhead and rotates in opposite direction to central pilot shaft with pilot cutter.

Fig. 2—Below—The drill, an action shot showing portability and safety, and a closeup of the cutterhead and pilot cutter

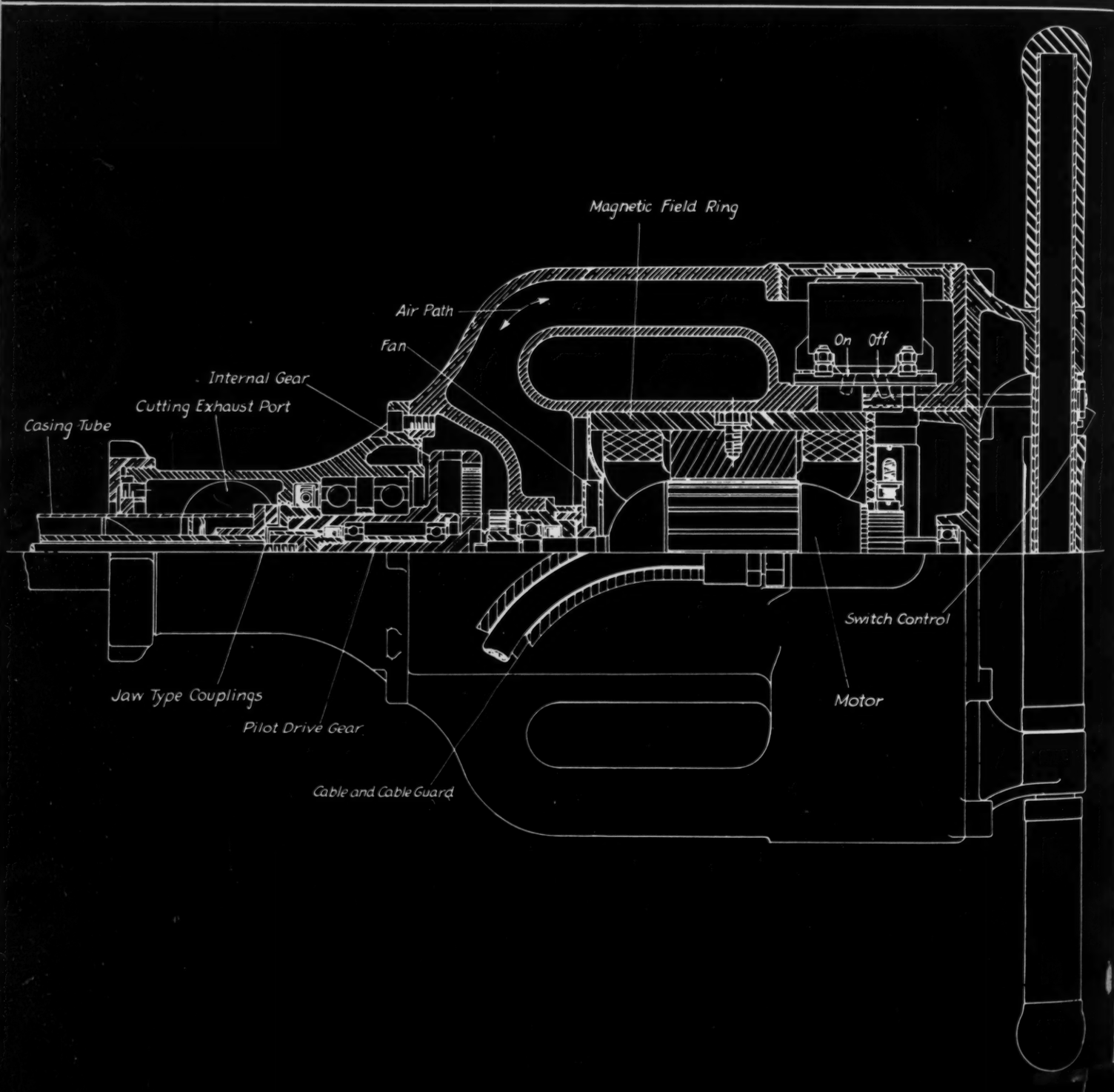


ciple of drilling is employed and torsional balance is achieved. The cross-sectional drawing in *Fig.* 1 and the picture of the cutterhead assembly in *Fig.* 2 clearly show the contrast with conventional twisted auger drills.

Like other mining machinery the drill was designed to be explosion-proof. It also had to be light enough to be handled by one man, yet strong enough to endure rough treatment encountered in mines. But in addition to possessing these features, the drill had to overcome other undesirable conditions: (1) Dangers incidental to prevailing drilling methods such as exposed, rapidly rotating augers, the silicosis hazard caused by raising of dangerous dusts, and "kick-backs" of torsionally unbalanced drills; (2) the necessity of using successively longer augers to drill a long hole; (3) impossibility of starting auger type drills without use of a pick or starting cavity; (4) short life of drill motors and the expense involved in adequate maintenance of machines.

Essentially the drill mechanism comprises a motor which drives a central or pilot shaft through a set of reduction gears. Driven by an internal gear about the pilot idlers, an outer tube rotates in a direction opposite to that of the pilot, as *Figs.* 1 and 3 show. The shaft terminates in a cutter, as does the tube,

Fig. 3—Cross section through the drill. Danger of kick-backs is eliminated by regulating speeds of the two oppositely rotating cutters to achieve torsional balance



both cutters being equipped with carboloy bits. The tube carries a spiral conveyor which transmits cuttings back to a dust-box in the housing from which they may be dropped into a containing bag. The menace of dust is eliminated.

With a housing of cast magnesium alloy, the entire motor case—a complete 3-horsepower explosion-proof mechanism—weighs only 43 pounds. Dangers of exposed rotating augers and of silicosis-fomenting dusts are definitely obviated by the stationary, tubular casing. The only exposed rotating part is the 1½-inch long cutter head with the pilot cutter, this construction permitting the grasping of the drill far forward. Drillers are enabled to control drill bars of indefinite lengths and to start a hole immediately with a full length bar against any condition of coal face.

Kick-Backs Constitute Hazard

To comprehend the design accomplishment of eliminating drill "kick-backs," it is necessary to understand drilling conditions. Coal is, of course, a non-homogeneous material and often contains wide fissures and voids in addition to hard materials such as pyritic sulphur. A drill in coal, therefore, cannot penetrate with the smooth, even motion of, say, a twist drill in mild steel. When an ordinary auger type drill is passing through coal, the driller not only has to hold the back of the drill down so that it will not rotate while the auger tends to grip fast against the sides of the hole. He also must guard against the unbalance caused by a sudden drill jump through a fissure and the possible lodging of the drill against an impenetrable substance. When this happens the auger holds fast and the drill with its long handles (necessitated by the leverage required to hold the machine steady originally) is rapidly rotated in a dangerous wild circle.

This hazard is eliminated by the Joy drill very simply. Speeds of the two oppositely rotating cutting members are so regulated that each carries an equal load in drilling and all of the torque is successfully balanced within the machine resulting in a smooth-running unit.

Motors have always presented special problems in coal drills, particularly auger types. Portability imposes definite limits on size and power of motors. Therefore the only method of reducing overload failures lies in reducing the actual load on the motor. In the new drill this is accomplished by using the inner cutter as a lead drill and breaking down some of the coal ahead of the cutting action performed by the larger diameter cutterhead. To minimize friction loads, ball bearings are used throughout. To assure a cooler running motor and to eliminate "hot spots" within the case, hollow side handles of the drill are utilized as a path for air circulated by a fan on the armature shaft of the totally enclosed motor.

Ease of assembly and maintenance was kept constantly in mind during development of the drill, resulting in many ingenious features which make all parts accessible. *Fig.* 4 illustrates this point. The starting switch, for example, can be assembled or removed without touching a wire or removing a mounting screw. To provide for this, switch leads are terminated by permanent spring contacts and the switch is held against them by a hand-hole cover plate. By removal of the rear end bracket covering the circular center of *Fig.* 4, complete access is had to all electrical parts. All connections are at the commutator end of the motor and the armature and fields may be removed through the opening. The fuse may be quickly reached by removal of the screw cover of the fuse cavity, and the boring bar and pilot shaft are articulated through jaw couplings that permit instantaneous assembly or disassembly.

The drill has been styled and balanced symmetrically for appearance. Its natural color is an attractive dull aluminum finish contrasting with the black rubber handles and cable guard. The exterior is, however, basically functional, without frills.

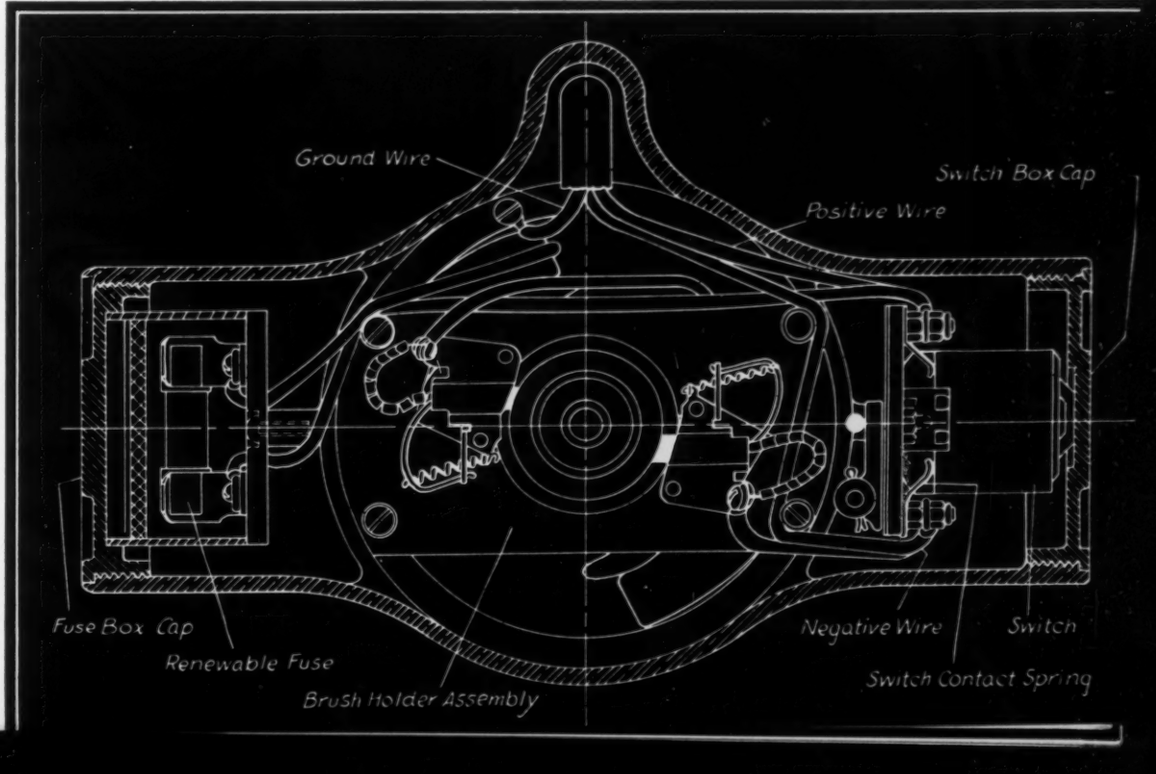
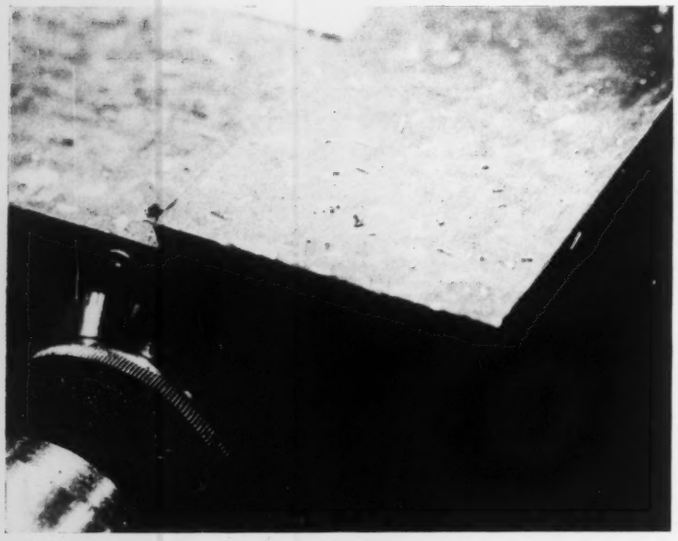
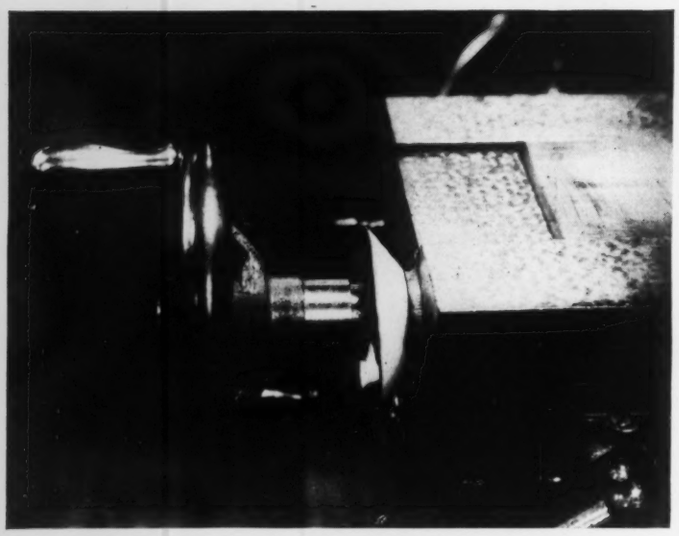
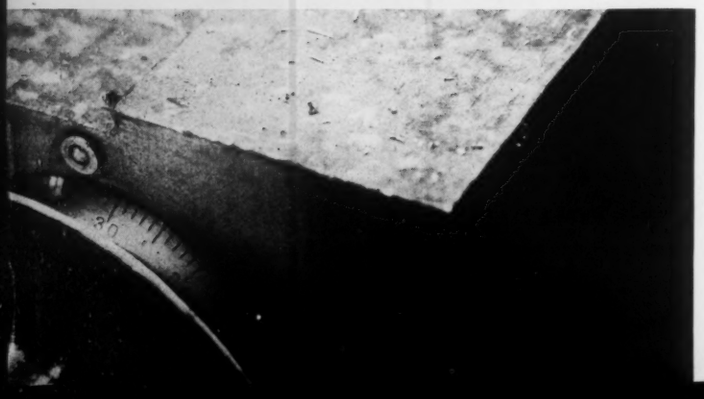


Fig. 4—Starting switch, fuse, and other electrical parts may be reached instantly, thus increasing ease of maintenance

Scanning the Field For Ideas



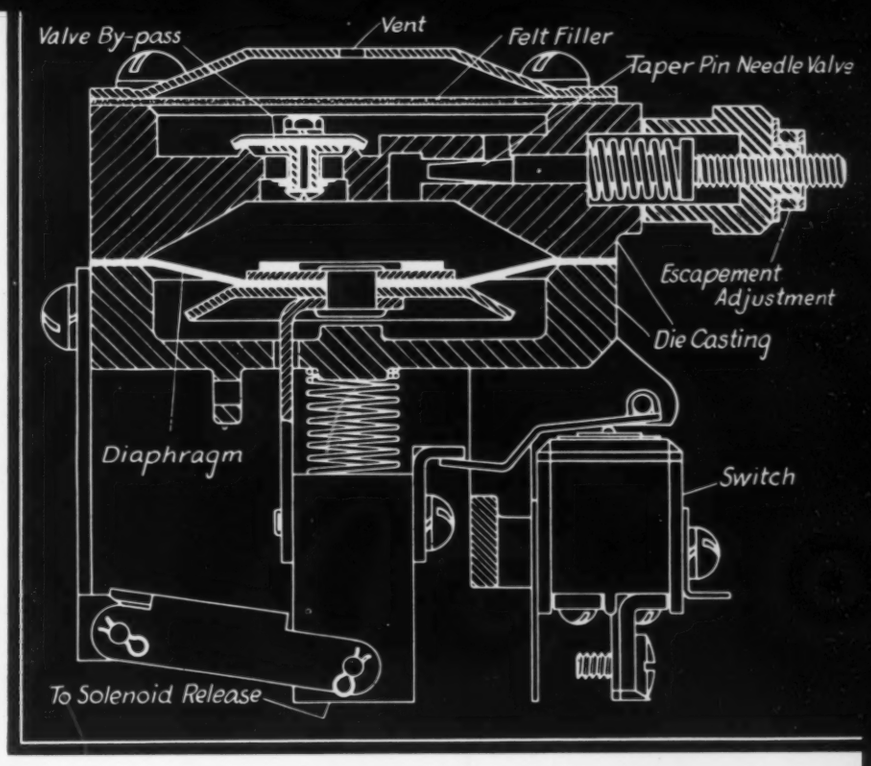




Reflecting surfaces have long been used for dark areas where more concentration of light is desired. Often a difficult part to illuminate satisfactorily however, is a graduated indicating dial. These are in many instances shaded by adjacent parts of the machine and in addition, being bright and circular, reflect only a narrow band of light. Consequently, as illustrated at top, there is poor visibility at the dial despite good lighting on horizontal surfaces.

A simple method of providing higher visibility of dials has been developed by the Illuminating Engineering Society. It consists of placing a small, truncated cone of sheet metal with a white baked enamel surface adjacent the dial as indicated in the center photograph. This collar is approximately 1-inch wide with a 45-degree angle. The white surface intercepts the general lighting in the room which is reflected to the metallic surfaces of the dial and the metal around the index point. These consequently show up clearly in comparison with their former appearance and the details are highly visible, as shown in the bottom photograph.

The scheme illustrated shows the value of light-reflecting surfaces situated so their reflection is picked up by the object desired. The same principal can often be applied to machines by painting with a light tint of high reflectivity. Light grays and creams lead in popularity for this purpose



Pneumatic timing devices provide sensitive operation and convenient adjustment over a relatively wide range of timing periods. These recognized advantages have been handicapped in the past, however, by faulty operation due to changing characteristics in the timing devices. Such limitations have been overcome in the time delay unit illustrated which has been developed by the Square D Co. Accuracy of this unit does not vary materially throughout its range of settings up to 3 minutes.

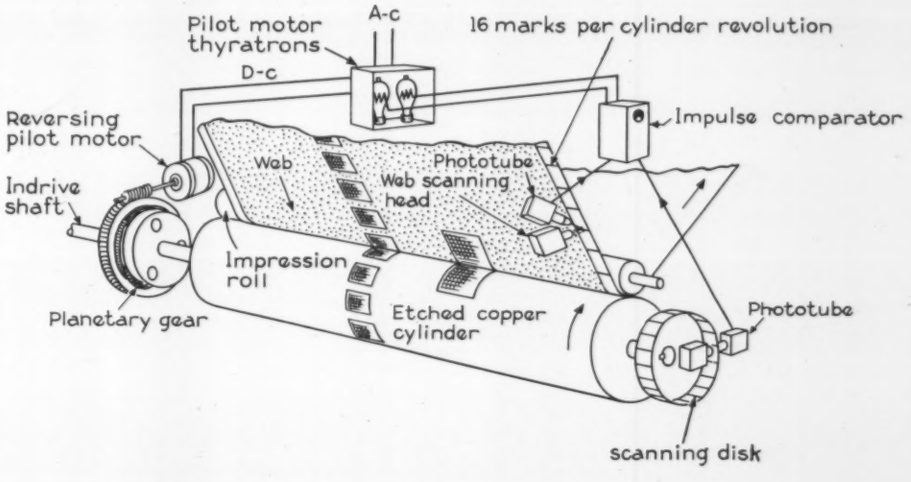
Utilizing a valve and spring-operated diaphragm, the cross-sectional view shows the operating principal of this timer. At the start of the timing period the neoprene diaphragm is held cupped upward by action of a solenoid on the operating block. Air previously in the chamber above the diaphragm has been transferred to the upper chamber through a by-pass valve. A felt filter keeps the pressure in this chamber at atmosphere at all times. In addition to excluding all foreign particles, this filter does not detract from the accurate operation of the timer due to its capacity for "breathing".

Timing operation is initiated when the force acting on the operating block is removed by either energizing or de-energizing the magnet coil. This allows the compressed operating spring to pull the diaphragm downward at a rate dependent upon the setting of a needle valve. At the end of travel the block operates a micro-switch controlling the delayed timing or dwell period for the operation required

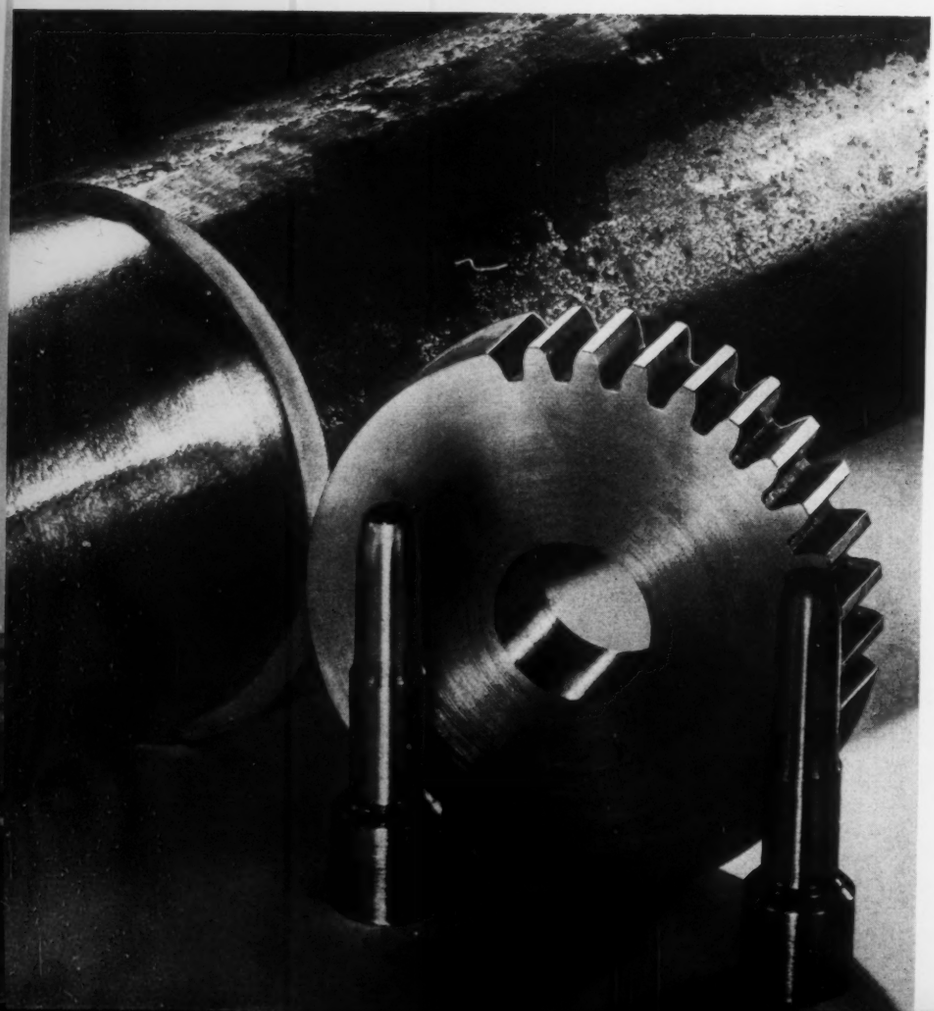
Automatic register control is shown schematically for a four-color printing press in the accompanying illustration. Involving the comparison of two sets of phototube impulses, this scheme provides extremely accurate control applying any correction needed 16 times for every revolution of the impression roll on each color unit.

Register marks are printed in web margin, on first impression, that is, at the first of the four rolls. These marks are scanned at succeeding impressions as additional colors are imprinted while at the same time cylinder phototube scanning heads observe the slotted disks connected to each impression roll. The phototube units are manually adjusted to synchronize, during the make-ready process.

Impulses from the two scanning heads for each color unit are compared in a mixing panel which correlates the time occurrence of each. If register correction is required the adjusting pilot motor of the roll in question makes the necessary correction. This motor is mechanically connected to reposition the roll through a planetary gear system. In addition to producing better printing jobs this system, developed by General Electric, reduces spoilage and allows the presses to operate at much greater speed. Pressmen have more time to supervise other functions



Maintaining Accuracy by Machining After Heat Treatment



STRESSED parts were designed until recently under the assumption that hardness of 350 to 375 brinell was the maximum at which parts could be commercially machined without the use of ultra-hard cutting tools. When hardness over this figure proved necessary, machining prior to heat treatment was specified, despite the undoubted disadvantages.

Machining of parts at 450 brinell or higher has become possible, however, through use of nickel-chromium-molybdenum steel of SAE 4340 or similar types, cut on modern machine tools of rigid construction. Conventional high speed cutting tools are used.

For removing large amounts of metal

Fig. 1—Top—Hydromatic propeller spiders of nickel-chromium-molybdenum steel, machined at 415 brinell. Fig. 2—Left—Gear blank partially machined from bar stock of same steel on ordinary lathe. Hardness is 477 brinell

with maximum speed and efficiency, machining prior to heat treatment while the steel is in a relatively soft condition is the most economical practice. Nevertheless, under certain circumstances machining before heat treatment has inherent disadvantages. Distortion and warpage are factors which accompany heat treatment, and while their effects may be minimized by various means, complete elimination of dimensional changes cannot be achieved. Consequently it is usually necessary to resort to straightening operations after heat treatment, or to leave sufficient excess metal in the initial machining operations to allow for possible warpage, and then grind or otherwise finish the part to required dimensions.

Either of these procedures has undesirable aspects. The straightening operation can introduce strains in the finished part which may be detrimental to service properties. The finishing operation subsequent to heat treatment requires setting up and re-aligning the part once more in the machine tool. This may endanger dimensional accuracy if the surfaces ground or shaved in this final operation must be related accurately to surfaces finished prior to heat treatment.

Another factor to be considered is the danger of strains resulting from the quenching operation. When a finished, or even rough machined part is quenched or otherwise cooled rapidly, internal stresses are developed which can be particularly severe at the periphery of holes, edges, sharp corners and fillets, or abrupt changes in section thickness.

Fig. 3—Shaft machined at 477 brinell. Machining after heat treatment obviates many difficulties

Heat Treating Simplified

Any technique permitting the economical machining of heat-treated steel at high hardness levels has the advantage of avoiding the undesirable features just mentioned and simplifies heat treating and machining practice. In some instances it may permit elimination of slower, more expensive grinding operations. Use of nickel-chromium-molybdenum steel has proved useful in these respects.

Chemical composition of this steel is .35 to .45 per cent carbon; .5 to .8 per cent manganese; 1.5 to 2 per cent nickel; .6 to .9 per cent chromium; and .2 to .3 per cent molybdenum. Table I lists mechanical properties.

In the automotive industry, heavy-duty truck axle shafts are produced from steel of this analysis (S.A.E. 4340) and splined on a hobbing mill at a hardness of 400 to 444 brinell to avoid necessity for reheat treatment of the splined end after machining. An average of 46 pieces per cutter grind is obtained. In certain cases the hardness of the shaft was increased to 500 brinell and machining conducted satisfactorily at reduced speeds and feeds.

TABLE I

Mechanical Properties of SAE X-4340 Steel

Tensile strength	230,000 p.s.i.
Yield point	210,000 p.s.i.
Reduction of area	47 per cent
Elongation, pct. in 2 in.	12 per cent
Izod impact	17 foot-pounds
Brinell hardness	477

The aircraft industry has found it profitable to use this steel, heat treated to 415-450 brinell, for propeller shafts, crankshafts, propeller spiders, undercarriage parts and engine mount fittings, all of which are highly stressed in service. *Fig.* 1 shows hydromatic propeller spiders machined at 415 brinell.

Instances have been reported in which industrial gear manufacturers have developed successful commercial practice for machining gears at hardnesses as high as 500 brinell. *Fig.* 2 illustrates a gear blank

partially machined from bar stock of nickel-chromium-molybdenum steel, heat treated to 477 brinell. Turning in this instance was accomplished in an ordinary lathe using a standard ⅝-inch square high speed steel tool with a 3/16-inch cut and a 1/32-inch feed at a speed of 18 surface feet per minute. A shaft completely machined at 477 brinell is illustrated in *Fig.* 3.

Machining at high hardness of gears and other wearing parts offers many interesting commercial possibilities. Machine gears, for instance, benefit by this increased hardness because they must be accurate and wear resistant to maintain over a long service life the smooth-running characteristics of the machine. If advantage is taken of the higher strength accompanying the increased hardness, gears may be redesigned to save appreciable weight. Heavy gears such as turbine reduction gears are ordinarily produced at relatively low hardness to avoid machining difficulties. Redesign of such gears on a higher strength basis permits reduction in the face width without exceeding the safe unit tooth load, and with resultant saving in weight and economy of material.

In a recent demonstration this type of steel heat treated to 450 brinell was machined on a standard turret lathe, using conventional high speed steel cutting tools. Machining operations were designed to illustrate a wide variety of cutting operations and included chamfering, turning, drilling and form tooling. The turning cut, in which the bar was reduced in diameter from 2 inches to 1½ inches, was performed at a speed of 49 feet per minute, with a feed of .0075-inch. These were used for demonstration purposes, and are not combinations which would be useful in commercial practice. A tightly wound helical chip with no tendency to tear, check or burn, resulted and a smooth surface was produced on the bar.

New X-Ray Tube Studies Interior of Rapidly Moving Parts

PROCEEDING a step beyond high speed photographic equipment which appears to stop rapid motion, a new ultra-high speed X-ray tube has been developed. It enables engineers to make X-ray "stills" of the inner structure of opaque objects such as machine parts which are moving at an exceedingly rapid rate or reacting to a sudden strong external force. At a recent meeting of the American Physical society Dr. Charles M. Slack, research physicist at the Westinghouse Lamp division, Bloomfield, N. J., explained the tube he and his associates developed.

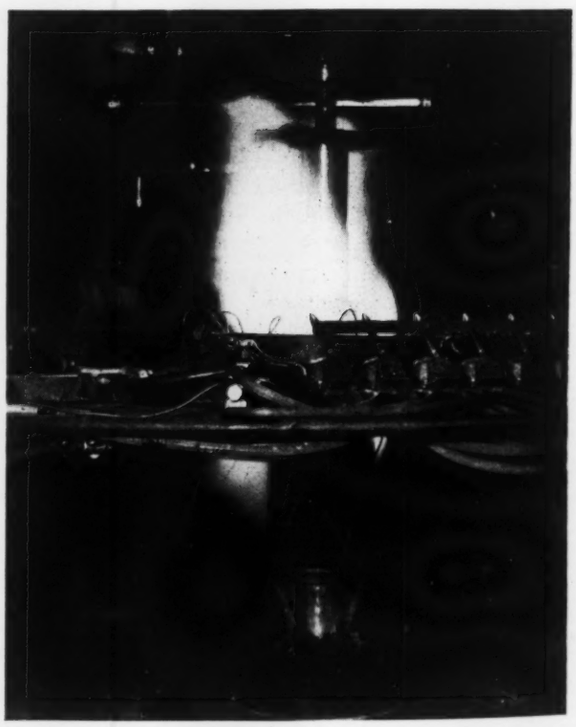
Whereas photographic equipment like that discussed in M .D., July, page 37, permits external study of machine motions, the new X-ray tube is expected to enable designers to watch internal stresses in rapidly moving parts. In a sense the functions of the X-ray and of photoelastic analysis will be combined.

But while the stroboscope and still camera permit exposures of approximately 1/100,000-second, the new X-ray tube receives a heavy surge of current for only one-millionth of a second, the X-ray film being exposed only that long. The contrast is even greater with conventional types of high speed X-ray equipment which permit exposure times of only one-hundredth of a second.

Higher Hardness Attained By Vertical Process

A HIGHER degree of hardness without measurable distortion in steel and alloy iron rolls, mandrels, etc., is claimed for a flame hardening process developed by Linde Air Products Co. and known as the vertical combination method. Hardness of steel cylindrical objects has been raised from 65 or 70 to approximately 90 on the type C scleroscope. At the plant of Farrel-Birmingham Co. Inc., Ansonia, Conn., a special dry sand alloy cast iron known as Farrelflame has been hardened to an average value of 80 on the scleroscope.

Thus far no distortion has been detected in rolls hardened in this manner. Overlap from the flame of



the old progressive method is eliminated because the new process is continuous, uses a large number of flame tips and is followed immediately by a water spray quench.

Applications in which this method has proved advantageous include rubber engraving rolls, embossing rolls, calender rolls, different types of mandrels where excessive pressure or wear must be taken into consideration, and certain applications for rolling mills, dough machines, and printing machinery.

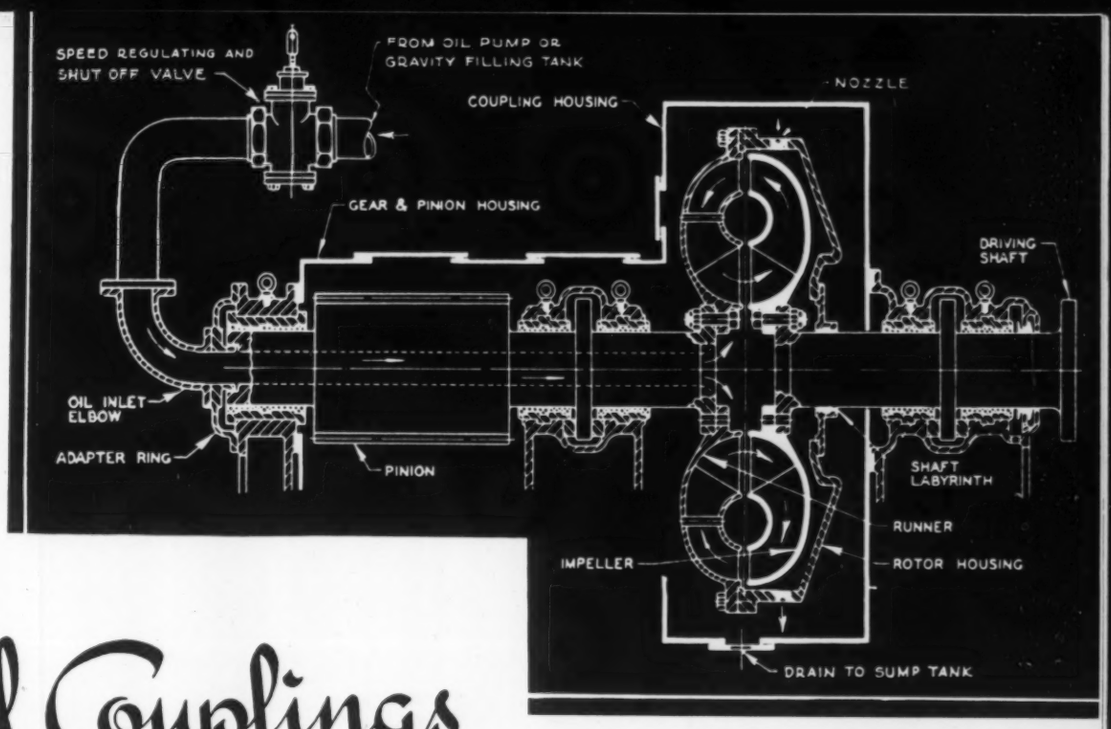


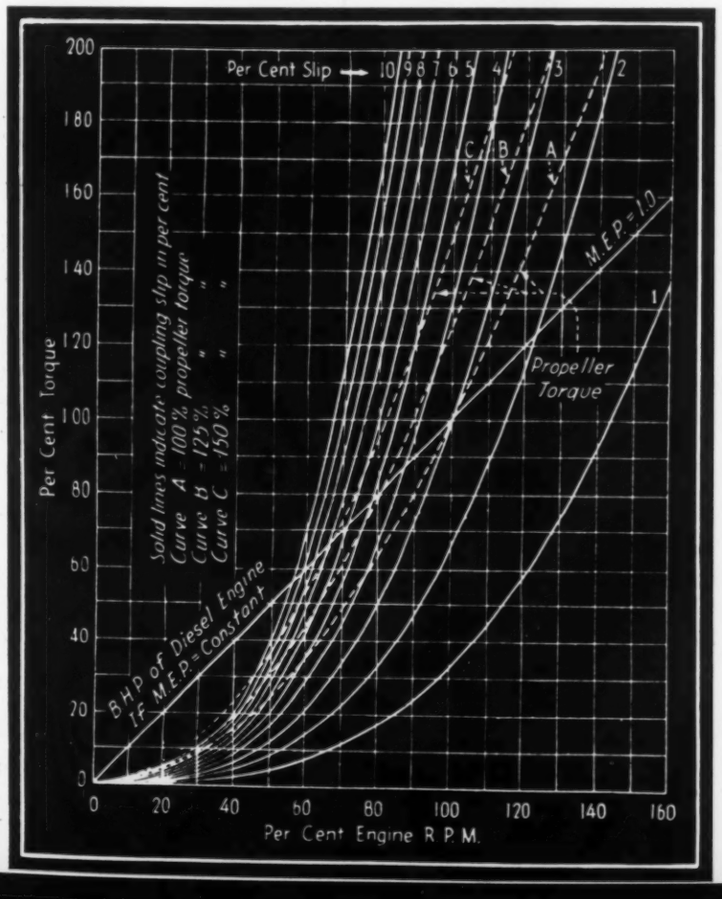
Fig. 1—Section through an hydraulic coupling and pinion of a typical marine gear. Pump delivers oil from sump tank into circuit

Fluid Couplings Improve Engine Performance

By N. L. Alison, R. G. Olson and R. Nelden

American Blower Corp.

Fig. 2—Coupling slip at certain engine speeds may be determined from these curves for any condition of operation where two or more engines are connected to a propeller through couplings and gears


Per Cent Slip
10 9 8 7 6 5 4 3 2
C B A
M.E.P.=1.0
1
Propeller Torque
Solid lines indicate coupling slip in per cent
Curve A = 100% propeller torque
Curve B = 125% " "
Curve C = 150% " "
B.H.P. of Diesel Engine If M.E.P.=Constant
Per Cent Torque
Per Cent Engine R.P.M.
0 20 40 60 80 100 120 140 160
0 20 40 60 80 100 120 140 160 180 200

TWO-ELEMENT hydraulic couplings, in contrast to torque converters, transmit power in a one-to-one torque ratio. Preventing the transmission of torsional vibrations and protecting engine and gears from sudden shock loads, the hydraulic coupling was first used aboard ship, a section through a coupling and pinion of a typical marine gear being shown in *Fig.* 1. It will be seen that a pump delivers oil from the sump tank into the working circuit of the coupling. Variable speed is provided by regulating the quantity of oil, and declutching is attained by shutting off or draining oil. In traction and industrial applications of hydraulic couplings, also discussed in this article, the units are self-contained and do not utilize an external tank or pump.

Exhaustive tests show that the efficiency of the marine hydraulic coupling always equals 100 minus the slip in per cent and that the torque input is equal to the torque output for all conditions of speed and filling. Although the coupling can be selected to operate with a slip as low as 1 per cent, corresponding to an efficiency of 99 per cent, it is customary in marine service to use couplings having a slip of between

From a paper presented before the Oil and Gas Power division, ASME.

2½ and 3 per cent in order to keep down the overall diameter. Since the power required by the oil-circulating pump amounts to approximately ¼ of one per cent of the engine horsepower, the overall efficiency of the coupling will be approximately 97 per cent. Rotating members are totally enclosed and all bolts are shrouded, so that loss due to windage is negligible.

It follows that if the engine speed is 500 revolutions per minute and the slip of the coupling is 3 per cent, the output shaft speed will be 485 revolutions per minute. An important characteristic is that the slip remains practically constant for all engine speeds, due to the fact that the power-transmitting capacity of the coupling and the power required by the propeller both vary as the cube of the speed.

Fig. 2 shows a set of curves from which coupling slip and engine speed may be determined for any condition of operation where two or more engines are connected to a single propeller through hydraulic couplings and reduction gears. The curves are drawn up on the basis of 3 per cent coupling slip with all engines operating and propeller absorbing designed torque. In addition propeller-torque curves are shown, one based on 125 per cent, the other on 150 per cent of designed torque, to indicate a possible foul-bottom condition or the ship operating with a heavy tow.

Although hydraulic couplings are used extensively for the variable-speed drive of fans, turboblowers, pumps, and machines requiring constant torque, the characteristics of the coupling when used for variable-speed propeller drive are perhaps not so well known. Curve *A* in *Fig.* 3 indicates the power required by a propeller in percentage of full power over a range from 100 per cent down to zero speed assuming that the load varies as a cube function of the speed. Curve *B* shows the power input to the hydraulic coupling based on the assumptions that the engine is running at maximum speed and the regulation of propeller speed is obtained entirely by varying the quantity of oil in the coupling circuit. It will be seen that the power input drops off rapidly and that the difference between curve *A* and curve *B*, representing the loss of power in the hydraulic coupling, varies from a maximum of 16 per cent of full power at 65 per cent speed to approximately 5 per cent at 20 per cent speed.

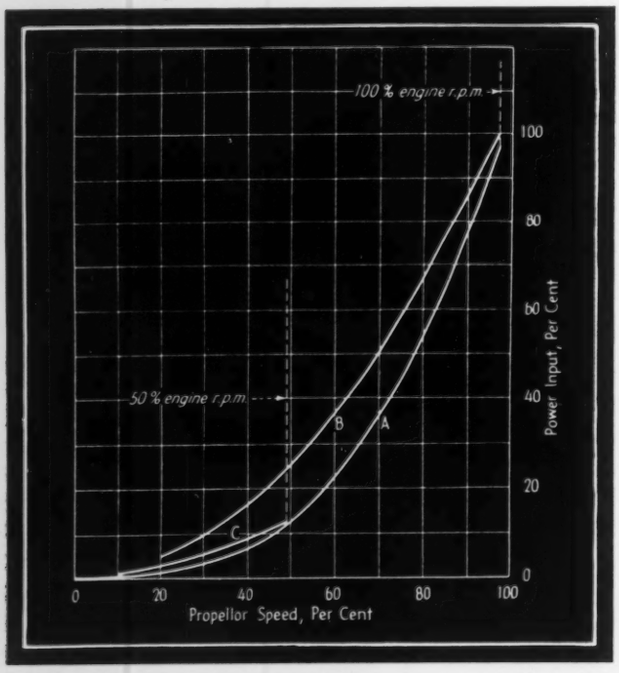


Fig. 3—Variable speed performance curve, A being horsepower at propeller, B the coupling input horsepower at full engine speed, C the input horsepower at half-speed

Curve *C* in *Fig.* 3 shows the power input to the hydraulic coupling assuming that the engine speed is reduced to 50 per cent of maximum and that the propeller speed is reduced down to 10 per cent of maximum by means of the hydraulic coupling. In this case the maximum power loss in the coupling, represented by the difference between curves *A* and *C* is only slightly over 2 per cent of full power, so that the heat to be dissipated is actually less than the normal slip loss of the coupling at full power. In this example it is assumed that the quantity of oil in the coupling would only be changed when propeller speeds below 50 per cent were desired.

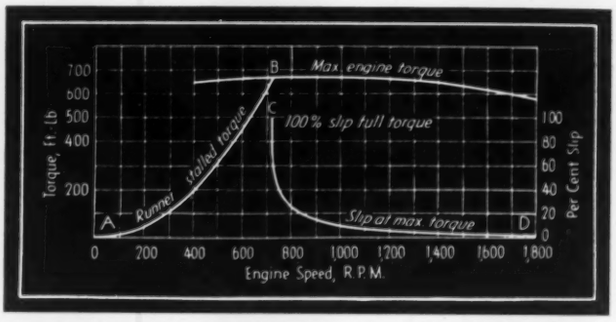


Fig. 4—Performance characteristics of a traction hydraulic coupling used as a power take-off are shown

The axial thrust of the hydraulic coupling when full of oil acts in the outward direction tending to separate the two members, while with the coupling only partially filled the thrust acts in the opposite direction tending to draw the two members together. Therefore it is necessary to provide bearings to take the thrust in both directions, and in marine applications this is usually handled by thrust collars on the driving and driven shafts.

Coupling thrust can also be handled by a ball or roller thrust bearing located in the center of the coupling, or by a bearing between the rotor housing and the driven shaft. The latter arrangement is frequently used in traction-type hydraulic couplings discussed later.

In connection with declutching, various types of quick-emptying valves are utilized with hydraulic couplings. Constant-leak nozzles are used on the coupling in *Fig.* 1, where rapid declutching is not required. By stopping the oil-supply pump or closing the oil inlet valve and permitting the coupling to empty through the nozzles in the periphery of the rotor housing, declutching is accomplished, two to five minutes being required to empty the coupling completely.

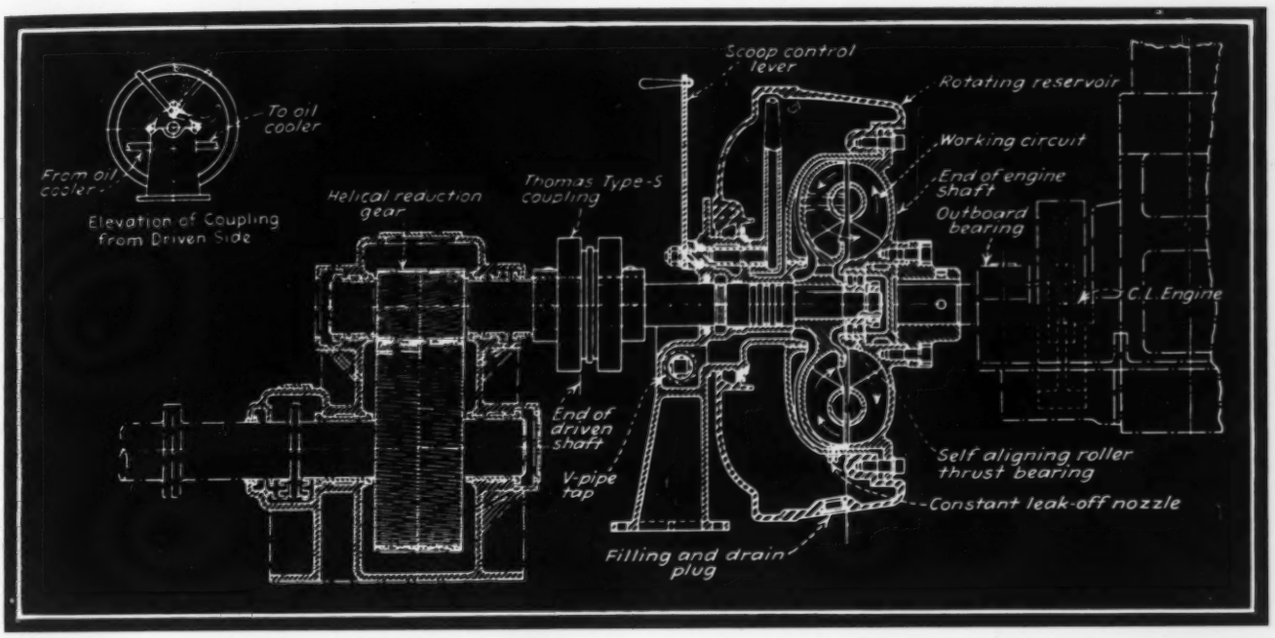


Fig. 5—Scoop control coupling, a self-contained unit used for certain diesel engine drives

A ring-type dumping valve permitting declutching in from three to five seconds is sometimes used with marine couplings, while a recent development is a piston valve type. Springs hold the piston valves closed around the periphery of the rotor housing, but oil or air pressure can be admitted to the valves to move the pistons axially, uncovering drain ports.

The traction coupling differs from the marine type in that in it no provision is made for completely disconnecting the driving from the driven member. A self-contained unit usually mounted directly on the engine flywheel or on an extension of the crankshaft, it operates with a fixed quantity of oil in the working circuit and does not require an external tank or pump. Heat generated within is dissipated by radiation.

Curve Shows Characteristics

Characteristics of the traction coupling, used as a power take-off with an internal combustion engine are shown in *Fig.* 4. Curve *C-D* shows the slip of the coupling from 100 per cent to 40 per cent engine speed when delivering maximum engine torque to the driven machine, and it will be seen that this slip increases from 2½ per cent at point *D* to 100 per cent at point *C*. This represents a full-throttle condition. Curve *A-B* represents the torque output from the coupling with the runner stalled and the engine operating at reduced speed. For example, in starting up, the drag torque at point *A* is zero and as the engine increases in speed the torque of the coupling immediately builds up toward point *B*, setting the driven shaft in motion. After this the slip of the coupling rapidly decreases and falls to about 2 or 3 per cent in the range of normal speed and load.

Ability of the coupling to prevent engine stalling is shown by curve *C-D* indicating how the effect of overload is to pull down the engine speed until point *C* is reached, when the slip rises to 100 per cent and the output shaft stalls.

In the traction coupling a ring-shaped baffle is attached to the coupling at the inner profile diameter, and serves to impede the oil circulation when working at high slip or when stalled, thus reducing the drag torque. The baffle has no effect on the slip at normal load and speed, and by varying its diameter the point of coupling stall when delivering full torque can be changed to suit the operating characteristics of the engine.

The reservoir on the back of the runner serves as an expansion chamber; consequently, there is no possibility of building up excessive pressure due to overheating of the oil in case the coupling is allowed to remain stalled for long periods with the engine developing full torque.

Another type of self-contained unit used for certain diesel-engine drives is the scoop control coupling shown in *Fig.* 5. It consists of an impeller to which is bolted an inner casing enclosing the runner, and an outer casing which acts as a reservoir and is of sufficient capacity to receive the contents of the working circuit. Calibrated nozzles in the inner casing allow a continuous flow of oil from the coupling circuit into the reservoir from where it is picked up by a scoop tube mounted on the external manifold. The scoop tube is connected to an external handle which can be moved through an arc of about 70 degrees.

With the scoop in its fully extended position, the coupling circuit is full of oil and minimum slip is obtained, while with the scoop in its retracted position all of the oil is in the reservoir and the coupling is completely disconnected. Thus this coupling can serve as a disconnecting clutch, and if variable output speed is desired this can be obtained by placing the control lever in an intermediate position. Oil handled by the scoop tube can be circulated through an oil cooler where extra cooling is required.

Accessibility Built In!

ACCESSIBILITY of built-in parts for servicing has been a foremost thought throughout the design of the television transmitting equipment developed by Farnsworth Television & Radio Corp. The console control station for this transmitter has all parts fully enclosed yet readily available when required. In this design appearance is also enhanced and protection against dust, etc. is provided.

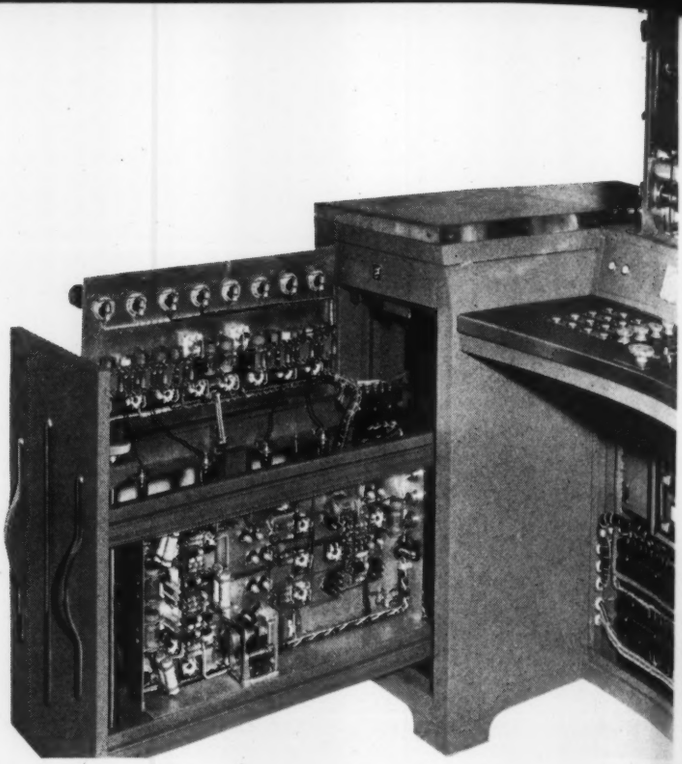
Built in the form of a desk, end panels form sliding drawers which when pulled out expose the assembled parts including the fading and output line amplifiers. These units are assembled on hinged panels, each readily swung out.

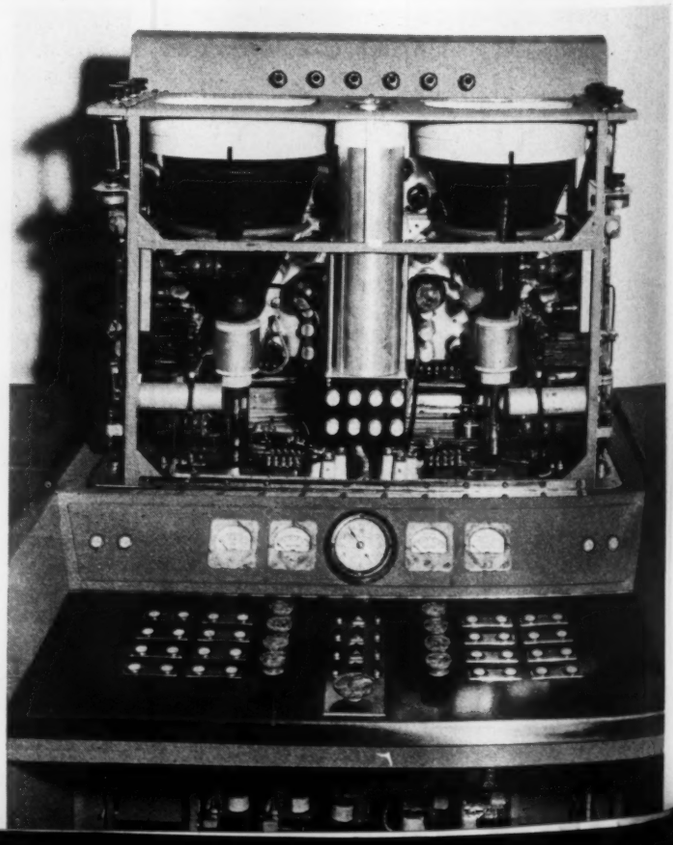
Chassis containing picture tube monitors, oscilloscopes and supplies is mounted in the central section of the console and is raised by motor drive. A mirror lid covers this unit when in closed position. The console permits simultaneous monitoring of two picture signals one of which is "on the air" and the other standing by. The picture tube and oscilloscope monitors show general appearance of picture as well as allow adjustments of the video and synchronizing signals to their proper amplitudes.

Four separate camera channels are used so any combination may be set up in either the standby or transmitting condition. A single knob controls the fade from one picture to another. Signal lights indicate the condition of each camera channel and the light circuits are parallel so that similar lights may inform the personnel required for operation.

Pushbuttons arranged in four rows operate remote motor control of the black level (brightness), video level (contrast), the camera electrical focus and the camera optical focus. Amplitude of the synchronizing signal is also pushbutton controlled. Timing program action is accomplished by an electric clock in the instrument panel.

Console is fabricated steel, finished in fine gray wrinkle with satin chrome trim. Top and surface of the control panel are covered with battleship linoleum in a harmonizing shade of blue.





Top—Console control for television transmitter is compact unit with all parts built-in yet highly accessible for service and maintenance. Center—Motor drive raises and lowers chassis containing picture tube monitors, oscilloscopes and supplies. Bottom—Hinged panels in sliding drawer permit compact design

Differential Gearing Protects Mechanisms

By John I. Blair

Chief Engineer
Worthington Mower Co.

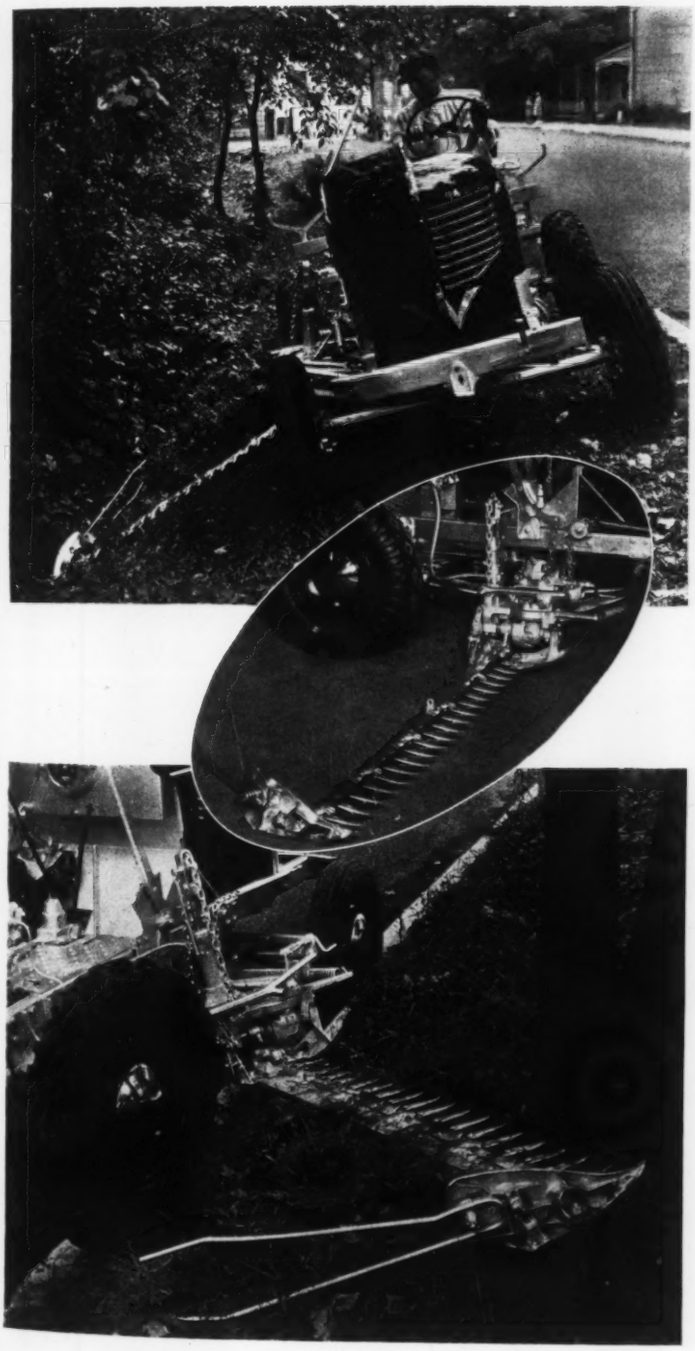


Fig. 1—Top—Provisions for increased angles of cut are necessary for mowing along highways. Insert shows sickle driving mechanism. Fig. 2—Bottom—Protection against damage is provided by allowing swing-back of bar

DESIGNERS are often faced with the problem of providing definite reciprocating action in a mechanism which in turn may operate about one or more fixed axes. When the machine involved is required to withstand unusual and varying operating conditions and yet be trouble free the problems are multiplied. Such are the requirements of a sickle mower for cutting grass on highways, golf courses and parks.

Sickle bar mowing has changed radically within the past few years and more exacting demands have been made for increased angles of cut so that all kinds of roadside conditions may be handled.

Driven from a power take-off and flywheel mounted on the tractor through a rigid pitman rod, sickle bars have been limited to a maximum of approximately 45 degrees above or below the horizontal or ground line. Beyond that point the pitman rod would jam causing severe strain and often breakage of the driving and supporting members. Many means have been devised to overcome this objection so that steeper banks and slopes could be cut.

These devices, in the main, have all employed some type of belt drive as means of transmitting the power from the take-off to a pitman flywheel on a revolving shaft mounted upon the hinge axis of the inner shoe. While this method of mounting the pitman flywheel solved the problem of delivering the stroke to the knife at any angle of inclination of the bar, many troubles were encountered such as belt slippage in wet conditions, the burning or ruining of belts when knives became jammed, etc. Also no swing-back or yielding of the bar against the hitting of unyielding obstructions could be provided without employing complicated and exposed revolving shafts and universal joints.

To handle all kinds of roadside mowing conditions no matter how steep the angle of up or down grade, the sickle bar machine illustrated in *Fig.* 1 has a particularly low center of gravity and automatic safety devices as well as other features of design for convenience and dependability.

Reciprocating differential drive mechanism located

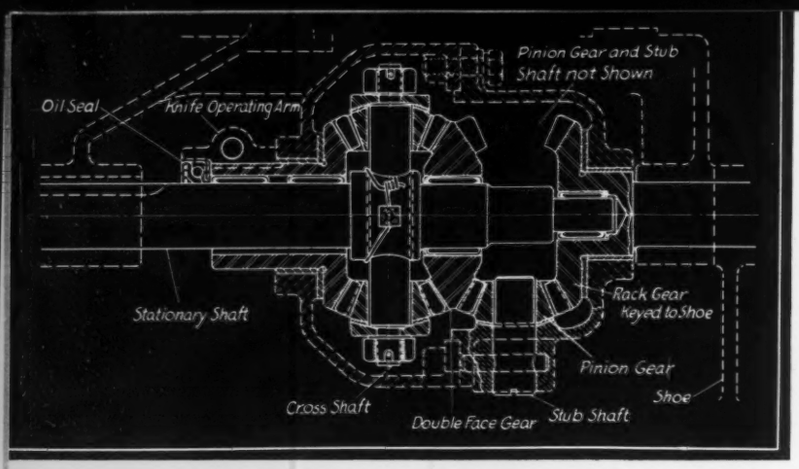


Fig. 3—Differential gear design transmits reciprocating action to sickle knives throughout range of cutting angles

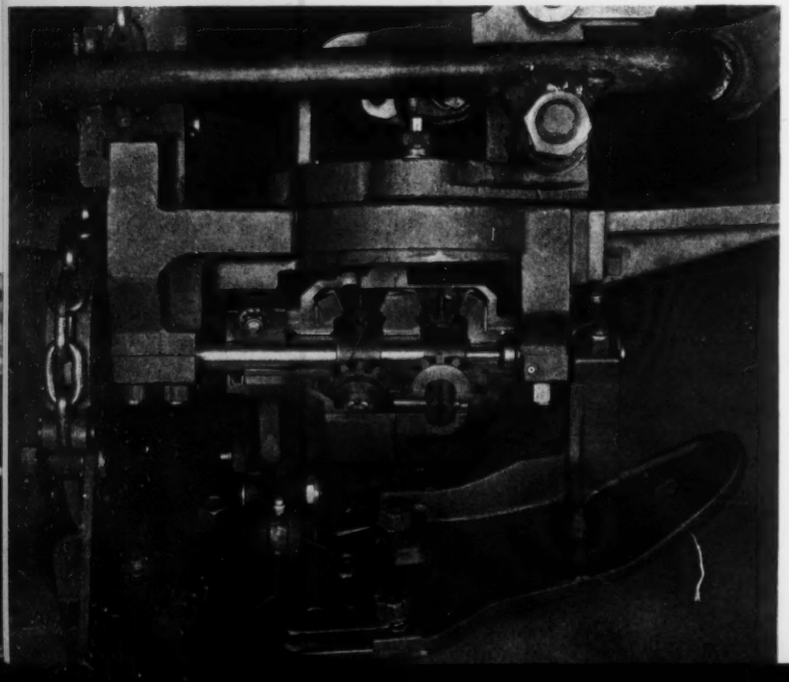
on the inner shoe would permit the operation of the sickle bar through practically a full 360 degree arc if it were not for the tractor chassis limiting its range. This entire driving mechanism is enclosed in grease and dustproof housings and runs in a bath of oil. It is direct driven from the flywheel through a pitman rod and the knife action is continuous for the full stroke of the rod at any degree.

Referring to *Figs.* 3 and 4 the pitman rod is connected at one end to a crankpin in the flywheel which is rotated by conventional power take-off on the tractor transmission. The other end is secured to an extension member of the differential gear housing by means of a ball and socket joint.

Gear housing carries two oppositely-mounted stub shafts on each of which is mounted a bevel pinion gear. These gears mesh on one side with a bevel rack gear keyed and clamped to an extension of the sickle bar shoe and on the other side with a double-faced bevel gear. A portion of the bevel rack gear is a journal for the right arm of a bracket member on the chassis, while the hub provides a journal for oscillating movement of the gear housing about the axis of gear and shaft. This shaft is keyed and clamped to the bracket arm as shown. The other end of the shaft is piloted in the bearing recess of the bevel rack gear.

This stationary shaft carries at right angle to its axis a cross shaft upon which are mounted two bevel

Fig. 4—Housing cut away to show differential gearing. Pitman drive is at top and knife drive linkage at lower left



pinion gears meshing with the other side of the double-faced bevel gear and another bevel rack gear, both of which are provided with roller bearings for oscillating movement. The latter gear has provided on its hub a journal portion for oscillating motion between gear housing and itself. It also has provided on a further extension of its hub a serrated portion to receive the serrated bore of the knife operating arm. This arm, shown in *Fig.* 4, is clamped to hub of the gear at proper mesh of serrations to bring about the best center register of knife sections at forward and rearward ends of the stroke.

Since the pitman rod is connected to an extension of the gear housing, reciprocation of the rod will effect oscillation of the housing about the axis of the stationary shaft and gear rack keyed to shoe extension. This oscillation will cause rotation and oscillation of pinion gears about their center axis because of their engagement with the normally stationary bevel gear. At the same time the pinion gears will oscillate with the supporting housing and stub shafts so that resultant oscillation of the intermediate bevel gear is effected which in turn imparts rotation and oscillation to the pinion gears about their center axis without, however, causing any angular movement of these pinion gears or the cross shaft about the stationary shaft. Oscillation or rotation of the pinion gears imparts oscillating movement to the bevel gear keyed to a knife operating arm. This movement will oscillate the arm which is connected to a ball-clamp link and

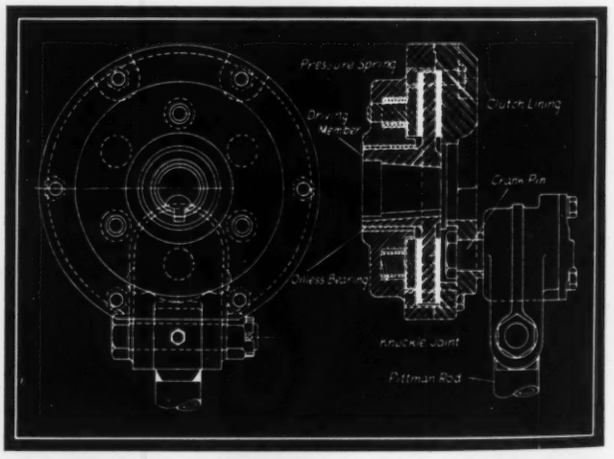


Fig. 5—Multiple dry disk automatic slip clutch on pitman flywheel gives added protection to mower parts

impart the desired reciprocating movement to the knife.

In the operating position the shaft is fixedly held in a bracket and supported in a pilot bearing in the gear rack keyed to the sickle bar shoe. When the sickle bar and shoe change their angular position, that is, rotate about the axis of the stationary shaft, the bevel gear rack will be similarly moved and when the pitman rod is stationary, the pinion gears will be rotated by the rack about their center axis without moving the gear housing. Similarly, the double-faced gear and the pinion gears on cross shaft will be rotated. The knife

(*Concluded on Page* 108)

Segmental Bearing Design Promotes Stability

By Hans Ernst

Director of Research
Cincinnati Milling Machine & Cincinnati Grinders, Inc.

SPINDLE flutter or change in position under load must be reduced to a minimum when highly accurate operation is necessary as in the precision grinder shown in *Fig.* 2. With the ordinary cap-type bearing, high accuracy has been attainable only through close clearances between journal and bearing, requiring delicate and frequent adjustments. Because the hazard of seizure is always present under these conditions, the life of such a bearing is sometimes short.

For an ideal precision spindle assembly the following characteristics would be necessary.

1. To prevent metallic contact an uninterrupted fluid film must be maintained between the spindle and the bearing.
2. Movement of the axis under changing forces must be as slight as possible.
3. The bearing must be able to support loads which might vary in direction through a wide angle.
4. Frictional losses in the bearing should remain practically constant regardless of fluctuations in the load.
5. The bearing should resist wear as much as possible and not require adjustment to meet varying conditions.

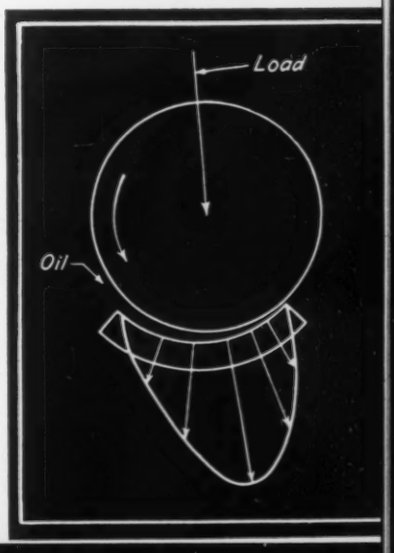
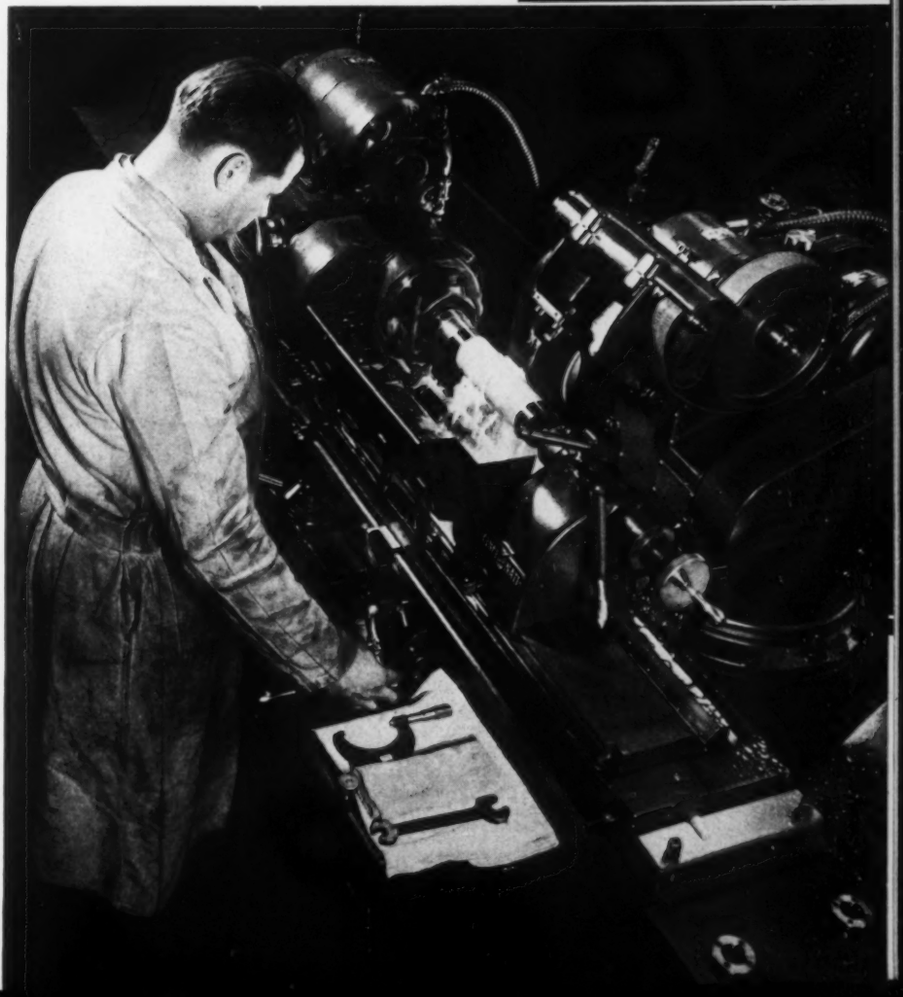


Fig. 1—Characteristic pressures built up by action of oil film with respect to applied load

Fig. 2—Grinding machines require bearings with high stability



When a journal revolves in its bearing the fluid adjacent to the journal is drawn in between the bearing and journal surfaces. Since the bearing surface is stationary, the fluid is in a state of shear. When the surfaces are close together and converge in a wedge shape in the direction of the journal movement, the shear is great and pressure is built up perpendicular to the surfaces. This pressure supports the journal with any load that it may be carrying and prevents metal-to-metal contact between the journal and the bearing. This action and the resultant normal pressures are shown in *Fig.* 1.

Causes Instability

In an ordinary bearing a single wedge-shaped oil film is developed which converges in the direction of rotation. Since the position and shape of the wedge varies with any change in direction or magnitude of the load on the journal, an unstable condition exists which causes displacement of the axis of the journal. This is accentuated by the fact that where the film diverges in

the direction of journal movement, as it must, a sub-atmospheric pressure may develop. If air is drawn in by this action, additional instability will result.

It is obvious that if the oil film is interrupted thinner films will be developed, and theoretically the stability and rigidity of the spindle will be increased. Breaking up the film by grooves and scrapers has been employed to obtain these thinner films. However, because this decreases the load-carrying capacity of the film it makes for less safety against seizure and short bearing life.

Promotes Spindle Stability

Pressures generated by the wedge-shaped film can be made to promote spindle stability if three or more wedges, equally spaced around the spindle, are formed. The high pressures generated act radially to hold the journal centered and away from the bearing. This principle is used in the Filmatic bearing which has been developed by Cincinnati Grinders Inc.

Instead of being solid, the bearing, as shown in *Fig.* 4, consists of segments which adjust the wedge in accordance with the load placed upon the journal. Acting together, the segments lock the spindle in its correct central location. Yet an uninterrupted film of oil is maintained between each jaw and the journal, so that spindle rigidity is secured without metal-to-metal contact. The coefficient of friction is practically the same as with antifriction bearings.

While early models showed improved performance over other bearings there was transverse movement of the spindle to the extent of about 50 microinches. Further study showed that this movement was due to two causes: Entrained air and momentary fluctuations in the oil supply. This was corrected by providing an air bleeder system and by maintaining the oil supply in the bearing chamber at higher than atmospheric pressure, thus insuring spindle stability at all times.

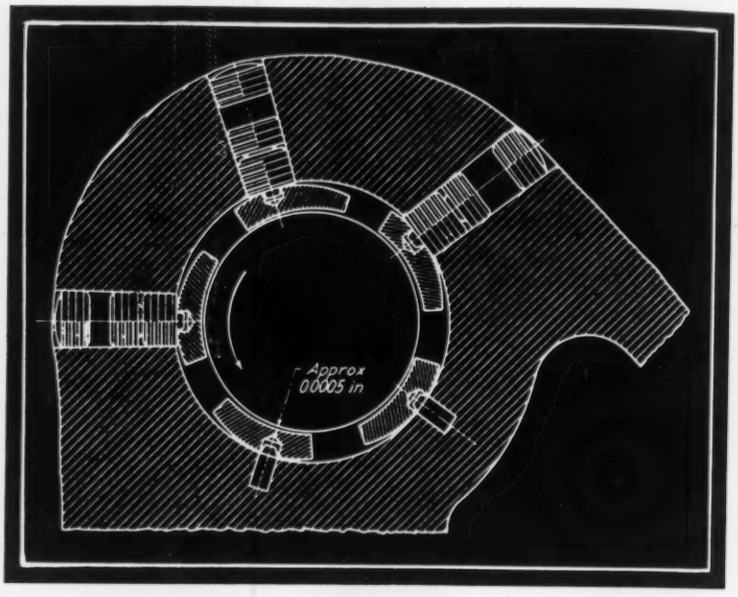


Fig. 4—Principal of bearing design utilizing segments. These segments adjust to load and oil pressures built up hold spindle central Segments are individually adjusted to provide .0005-inch clearance

Bearing and spindle assembly are shown in cross section in *Fig.* 3. Oil is supplied to a large central chamber by an independently motor-driven pump. A relief valve maintains the oil pressure in the chamber at the desired point, while air which becomes entrained is liberated through an air bleeder shown above central chamber.

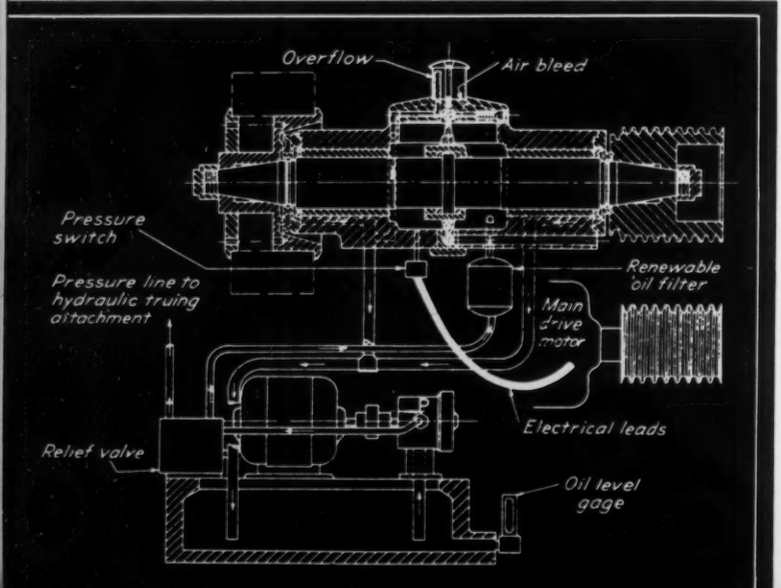
Pressure Assured Before Starting

To prevent danger of damage from starting the spindle before adequate pressure exists in the oil chamber, the spindle motor is started through a pressure switch which acts through a relay. Spindles in an ordinary precision bearing of the cap type flutter as much as 60 microinches vertically and about 25 microinches horizontally. Oscillograms of this bearing design show no perceptible flutter in either plane of movement.

It is well-known that in grinding with a machine which has even a moderately loose spindle, the grinding wheel "hammers" against the work and is consequently subjected to such severe stresses that it is necessary to use a wheel of harder grade than would otherwise be necessary. With machines equipped with the new type of bearing it is possible to use wheels two grades softer than would otherwise be possible. This permits of more efficient grinding, less frequent truing, which results in longer wheel life and higher grade production.

Spindles used in these bearings are chrome-nickel steel and bearing shoes are steel lined with a high lead bronze. However, other types of bronze have been successfully used, as have cast iron and phenolic-resinoid bearings. The lubricating fluid may cover a wide variety of compositions and viscosities ranging from 30 to 200 seconds Saybolt.

Fig. 3—Diagram of bearing and spindle assembly shows method of providing independent oil supply and bleeding of entrapped air for high stability



Calculating Stresses in Engine Parts

By

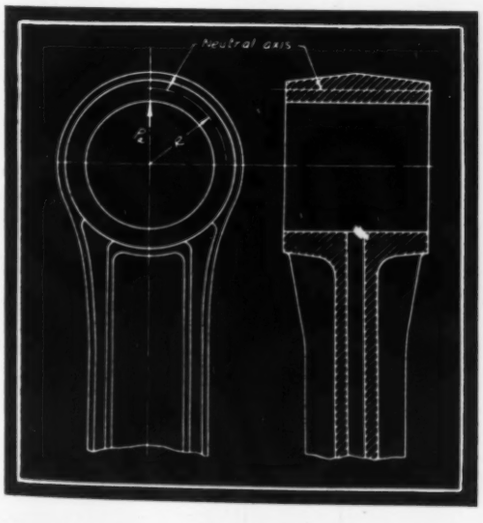
R. L. Boyer and T. O. Kuivinen

The Cooper-Bessemer Corp.

INCREASE in engine speeds has magnified the importance of the weight of reciprocating parts, and in order to secure minimum weight and still retain maximum rigidity and allowable stress, most rule-of-thumb methods have had to be discarded in favor of careful design. In many cases, however, practical rather than theoretical considerations determine the design of a part, regardless of whether or not it can be logically and mathematically analyzed. Largely from the viewpoint of the heavy duty engine designer, suggested rules of design for reciprocating parts are given in this article. Greater emphasis is given the trunk piston engine although crosshead types are also considered.

PISTONS: The head of a piston should logically be considered as a uniformly loaded plate with fixed edges. If it were freely supported the maximum stress would always be at the center; but considering the plate fixed at the edges, most authorities agree the maximum stress occurs at the edges. It has been generally admitted in recent years that the ideal design for the head

From a paper presented before the Oil and Gas Power division, ASME.



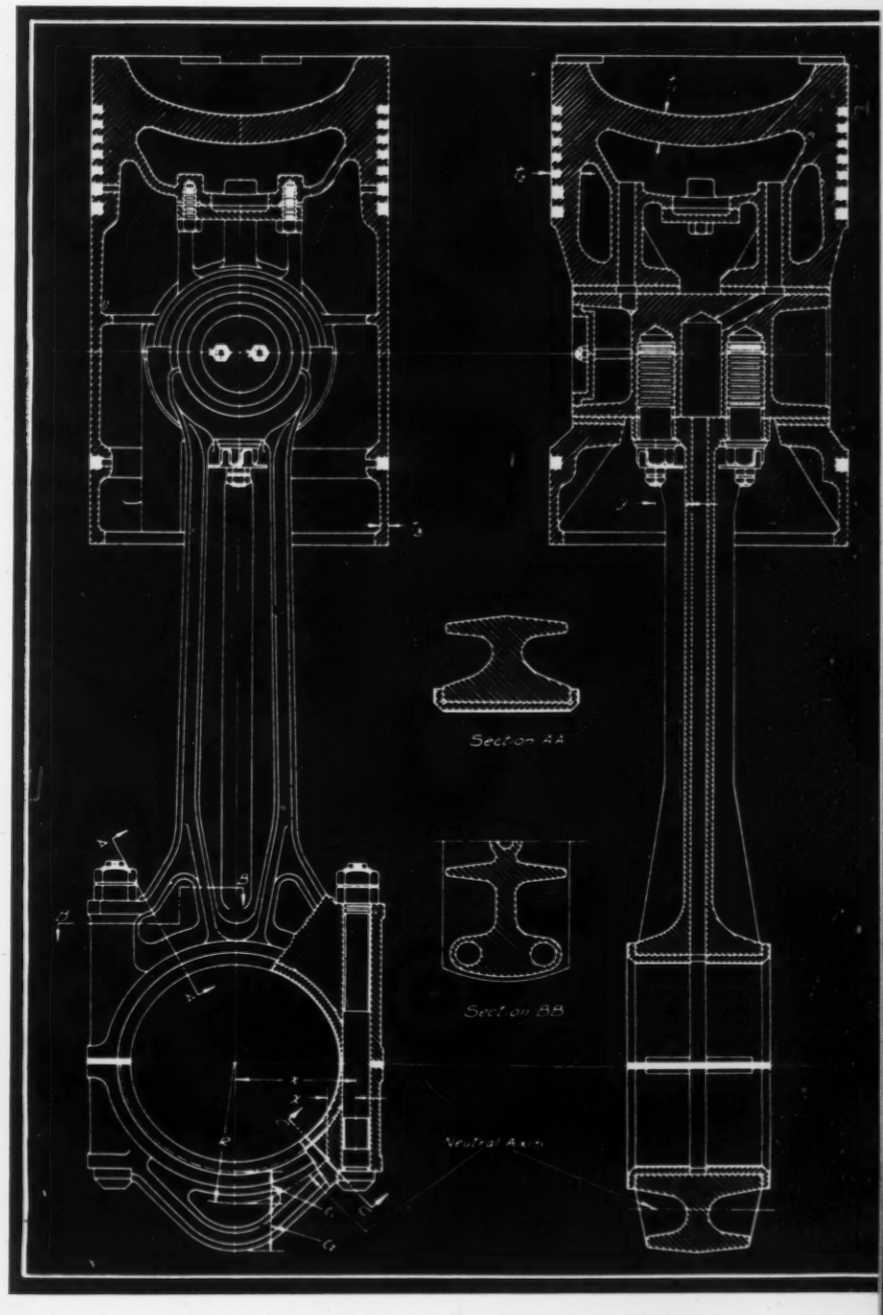


Fig. 1—Above—Shape of the piston head and its point of joining into the side walls must be such as to permit head flow readily without creating stresses. Cooled piston heads are less thick

Fig. 2—Left—When a definite wristpin diameter is known, bearing performance experience permits choosing a definite clearance between wristpin eye and pin. Curved beam formulas give bending stress

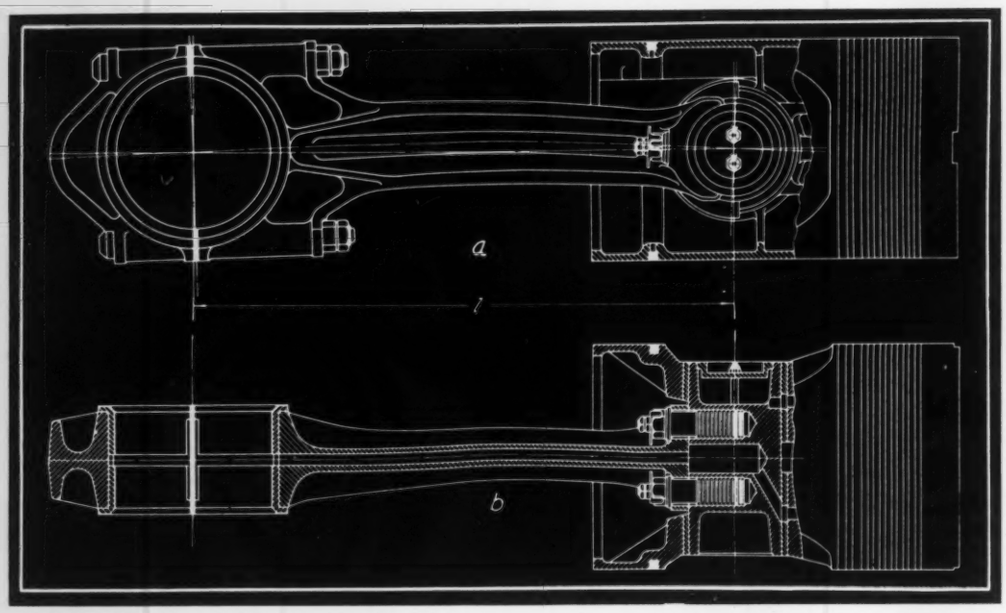


Fig. 3—Left—Sections A and B illustrate rule that ends of connecting rod are considered free or fixed, depending on bending plane

Fig. 4—Below—Correction factors for various types of cross sections, applied after using straight beam stress formulas

of the piston is that of uniform thickness. For uniform thickness and a uniform load with fixed edges the maximum stress at the edge becomes:

$$S = \frac{3\,wr^2}{4t^2} \quad \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots (1)^1$$

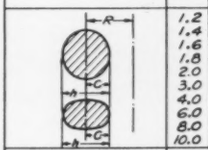
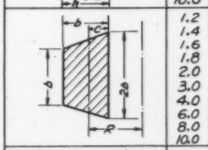
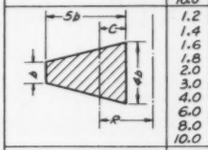
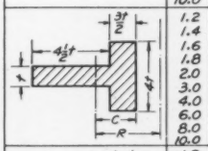
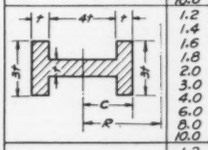
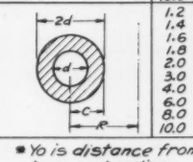
and the stress at the center becomes:

$$S = \frac{3\,wr^2}{4t^2}(1+m) \quad \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots (2)$$

where S = tension stress, pounds per square inch; w = distributed load, pounds per square inch; r = radius of plate to point of fixation, inches; t = thickness of plate, inch; and m = Poisson's ratio, approximately .3.

Aside from mechanical-stress considerations, however, the head-flow factor is probably of greater importance. Shape of the piston head and its point of joining into the side walls must be such as to permit head flow readily without creating concentrated stresses. It is difficult to state a definite rule for the thickness of piston heads from the standpoint of heat flow because each design is a distinct problem in itself, being dependent upon such factors as compression pressure, cycle, operating speed, type of service, horsepower, and ring setup. In aluminum alloys it is also necessary to consider whether the piston is a forging, a sand casting, a semi-permanent mold casting, or a full permanent mold casting. Taking this into consideration, in addition to mechanical stresses, the thickness of the piston head has finally become a rather empirical value secured through experience.

VALUES OF CONSTANT 'K' FOR CURVED BEAMS

Section	R/C	Values of K: Inside Fiber	Values of K: Outside Fiber	Yo/R *	Section	R/C	Values of K: Inside Fiber	Values of K: Outside Fiber	Yo/R *
	1.2	3.41	0.54	0.224		1.2	2.89	0.57	0.305
	1.4	2.40	0.60	0.151		1.4	2.13	0.63	0.204
	1.6	1.96	0.65	0.108		1.6	1.79	0.67	0.149
	1.8	1.75	0.68	0.084		1.8	1.63	0.70	0.112
	2.0	1.62	0.71	0.069		2.0	1.52	0.73	0.090
	3.0	1.33	0.79	0.030		3.0	1.30	0.81	0.041
	4.0	1.23	0.84	0.016		4.0	1.20	0.85	0.021
	6.0	1.14	0.89	0.0070		6.0	1.12	0.90	0.0093
	8.0	1.10	0.91	0.0039		8.0	1.09	0.92	0.0052
	10.0	1.08	0.93	0.0025		10.0	1.07	0.94	0.0033
	1.2	3.01	0.54	0.336		1.2	3.09	0.56	0.336
	1.4	2.18	0.60	0.229		1.4	2.25	0.62	0.229
	1.6	1.87	0.65	0.168		1.6	1.91	0.66	0.168
	1.8	1.69	0.68	0.128		1.8	1.73	0.70	0.128
	2.0	1.58	0.71	0.102		2.0	1.61	0.73	0.102
	3.0	1.33	0.80	0.046		3.0	1.37	0.81	0.046
	4.0	1.23	0.84	0.024		4.0	1.26	0.86	0.024
	6.0	1.13	0.88	0.011		6.0	1.17	0.91	0.011
	8.0	1.10	0.91	0.0060		8.0	1.13	0.94	0.0060
	10.0	1.08	0.93	0.0039		10.0	1.11	0.95	0.0039
	1.2	3.14	0.52	0.352		1.2	3.26	0.44	0.361
	1.4	2.29	0.54	0.243		1.4	2.39	0.50	0.251
	1.6	1.93	0.62	0.179		1.6	1.99	0.54	0.186
	1.8	1.74	0.65	0.138		1.8	1.78	0.57	0.144
	2.0	1.61	0.68	0.110		2.0	1.66	0.60	0.116
	3.0	1.34	0.76	0.050		3.0	1.37	0.70	0.052
	4.0	1.24	0.82	0.028		4.0	1.27	0.75	0.029
	6.0	1.15	0.87	0.012		6.0	1.16	0.82	0.013
	8.0	1.12	0.91	0.0060		8.0	1.12	0.86	0.0060
	10.0	1.12	0.93	0.0039		10.0	1.09	0.88	0.0039
	1.2	3.63	0.58	0.418		1.2	3.55	0.67	0.409
	1.4	2.54	0.63	0.299		1.4	2.48	0.72	0.292
	1.6	2.14	0.67	0.229		1.6	2.07	0.76	0.224
	1.8	1.89	0.70	0.183		1.8	1.83	0.78	0.178
	2.0	1.73	0.72	0.149		2.0	1.69	0.80	0.144
	3.0	1.41	0.79	0.069		3.0	1.38	0.86	0.067
	4.0	1.29	0.83	0.040		4.0	1.26	0.89	0.038
	6.0	1.18	0.88	0.018		6.0	1.15	0.92	0.018
	8.0	1.13	0.91	0.010		8.0	1.10	0.94	0.010
	10.0	1.10	0.92	0.0065		10.0	1.08	0.95	0.0065
	1.2	2.52	0.67	0.408		1.2	2.37	0.73	0.453
	1.4	1.90	0.71	0.285		1.4	1.79	0.77	0.319
	1.6	1.63	0.75	0.208		1.6	1.56	0.79	0.236
	1.8	1.50	0.77	0.160		1.8	1.44	0.81	0.183
	2.0	1.41	0.79	0.127		2.0	1.36	0.83	0.147
	3.0	1.23	0.86	0.058		3.0	1.19	0.88	0.067
	4.0	1.16	0.89	0.030		4.0	1.13	0.91	0.036
	6.0	1.10	0.92	0.013		6.0	1.08	0.94	0.016
	8.0	1.07	0.94	0.0076		8.0	1.06	0.95	0.0089
	10.0	1.05	0.95	0.0048		10.0	1.05	0.96	0.0057
	1.2	3.28	0.58	0.269		1.2	2.63	0.68	0.399
	1.4	2.31	0.64	0.182		1.4	1.97	0.73	0.280
	1.6	1.89	0.68	0.134		1.6	1.66	0.76	0.205
	1.8	1.70	0.71	0.104		1.8	1.51	0.78	0.159
	2.0	1.57	0.73	0.083		2.0	1.43	0.80	0.127
	3.0	1.31	0.81	0.038		3.0	1.23	0.86	0.058
	4.0	1.21	0.85	0.020		4.0	1.15	0.89	0.034
	6.0	1.13	0.90	0.0087		6.0	1.09	0.92	0.014
	8.0	1.10	0.92	0.0049		8.0	1.07	0.94	0.0076
	10.0	1.07	0.93	0.0031		10.0	1.06	0.95	0.0048

* Yo is distance from centroidal axis to neutral axis, where beam is subjected to pure bending

The following values of t_1, shown in *Fig.* 1, have been found quite successful:

Four-cycle diesel, cast iron ... t_1 = .11D to .13D
Four-cycle gas, cast iron .... t_1 = .12D to .14D
Four-cycle diesel, aluminum .. t_1 = .13D to .16D
Two-cycle diesel, cast iron ... t_1 = .16D to .18D
Two-cycle gas, cast iron ..... t_1 = .20D to .22D

where D = piston diameter, inch. These values apply only to noncooled pistons. Thickness of cooled piston

[1] Grashof's formulas as given in Eshbach's *Handbook of Engineering Fundamentals.* Also developed by Timoshenko in *Applied Elasticity,* by Timoshenko and Lessells.

heads may and should be materially less than the above.

WRISTPINS: Minimum deflection is desired in wristpins to maintain uniform distribution of load on the wristpin bearing. Some types of wristpin constructions result in high bearing pressures, and this uniform distribution of load is necessary in order to avoid areas of highly concentrated bearing pressures and subsequent damage to the wristpin bearings. A successful method of obtaining rigidity in wristpins and lightweight reciprocating parts, so as to obtain uniform loading on the wristpin bearing is illustrated in *Fig.* 1.

Method Is Controversial

CONNECTING RODS: The wristpin eye of solid eye type of connecting rods wherein the eye is round (not wedge-adjusted wristpin bearings) may be designed as follows for stresses and deflections[2]. This method gives lightweight construction without excessive bending stresses and has been actually checked experimentally by the authors on model connecting-rod eyes and found satisfactory. Method of calculation of connecting-rod eyes has always been a controversial subject, however.

Knowing a definite wristpin diameter, bearing performance experience will enable the designer to choose a definite clearance between wristpin eye and the pin. Pull on the ring necessary to take up this clearance is

$$P = \frac{\delta EI}{.137R^3} \quad \ldots\ldots (3)$$

where P = pull on the eye, pounds; E = reduction of eye diameter in a plane 90 degrees to the load P, inch; I = cross section moment of inertia; R = radius to neutral axis of ring cross section, inch, as shown in *Fig.* 2. Then the bending moment at the point of load application is

$$M = .318\,PR \quad \ldots\ldots (4)$$

From the foregoing moment M, the bending stress can be determined by the formulas for curved beams as will be discussed later.

[2] See pages 436 to 440 of Timoshenko's *Strength of Materials*, 1930 edition.

The eye cross section should be small enough so that P, as determined by equation (3), comes out considerably less than the actual load to be applied on the connecting rod eye. Calling the actual load P_a, the direct tensile stress on the cross section of the top of the eye is

$$S_t = P_a/2A \quad \ldots\ldots (5)$$

where A = cross-sectional area of the eye. Maximum tensile stress in the eye is the sum of the stress from the bending moment M, equation (4), and the direct tensile stress obtained from equation (5).

In addition to considering direct stress on the minimum cross-sectional area, it must be remembered the connecting rod is a column and should be designed for safe stress as a column. When bending in the plane of the crankshaft centerline both ends of the column are considered fixed with the column length as the distance from crankpin centerline to wristpin centerline (*Fig.* 3b). Rankine's formula for short columns has been found to be the most satisfactory, as very rarely is the l/r ratio of connecting rods greater than 120. When bending in a plane 90 degrees to the crankshaft centerline the ends of the rod are considered free (*Fig.* 3a). Thus in the latter direction the cross section of the rod must be designed with a greater radius of gyration r than in the other direction. Rankine's formula for short columns is

$$S_c = (P/A)[1 + k(l/r)^2] \quad \ldots\ldots (6)$$

where P = total thrust load on rod, pounds; A = cross-sectional area at midpoint of rod, square inches; k = .00004 for columns of fixed ends; k = .00016 for columns with free ends; l = length of rod from centerline of crankpin to centerline of wristpin, inches; r = radius of gyration of midpoint cross section in the direction that bending is being considered, inches; and Sc = column stress, pounds per square inch. This latter value should not exceed the ultimate tensile strength of the material divided by the factor of safety 6.5.

Using this method of design, it is obvious that the maximum stiffness and strength with the minimum weight of material are obtained by the use of I-beam

(*Continued on Page* 112)

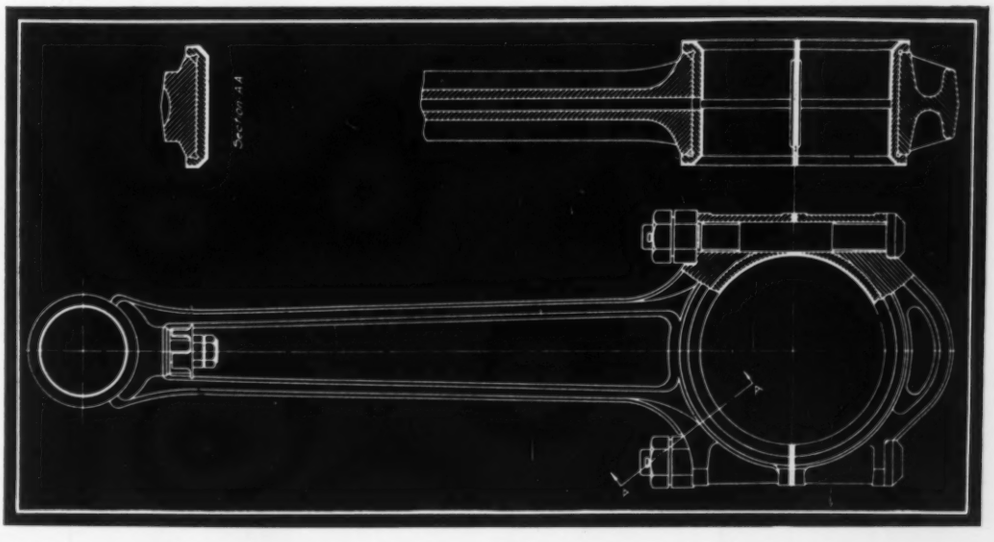


Fig. 5—A lightweight design that caused considerable difficulty in broken bolts because of deflection of the rod foot. Compare with Fig. 1

Determining Friction Losses in Rotating Parts

By H. M. Edmunds

Research Engineer
Crocker-Wheeler Electric Mfg. Co.

IT IS common experience that when all sources of power are withdrawn from a rotating machine, it will gradually diminish in speed and finally come to rest. The only driving power remaining is the momentum of the rotating masses and the retarding forces reducing the speed are the various frictions, windage, etc., which gradually absorb this stored energy.

In certain cases there is no difficulty in making use of this phenomenon and thus obtaining valuable data of assistance to the designer. The question of correct fan design for electrical machines, for instance, is one of great importance. Not merely must the ventilating fan be well designed to avoid unnecessary power consumption, but the economic balance between power used for ventilating and the saving of active material in consequence of artificial cooling has to be determined to obtain the best relative "weights" of the various elements.

Is Reasonably Accurate

A reasonably accurate determination of the inertia of the rotating masses, WR^2, is important for two reasons: First, because this figure is needed in experimental determination of windage and friction losses, and secondly, because in many duty cycles with frequent starts and stops, the energy expended in accelerating and decelerating such masses is frequently the determining factor in the question of selecting the correct size of unit to be used.

The following discussion covers a simple and easily applied method of finding WR^2 and then shows how the figure so found can be used in a further test to measure windage and friction losses. While the principles involved are well known, the method as worked out in practical detail is novel. The system is confined to machines with antifriction bearings.

The method is really an adaptation of Atwoods machine in which a flexible cord is firmly secured to the shaft by wedging it in the keyway. Sufficient cord is neatly wound on the shaft to allow the weight to fall about 10 feet as shown in the accompanying sketch. The cord is marked at one foot intervals and a pulley of minimum friction fixed above so as to allow for a 10-foot fall of the weight. By this system a known torque is applied and time of fall of the weight measured with a stop watch for each foot of the total fall.

In figuring the applied torque half the thickness of the cord should be added to the radius of the shaft. It is advisable to repeat the test with two or three different weights as a check of the accuracy and the applied torque should be about 1 inch pound for every 10 lb. ft.^{2} of the rotor. An approximate value for WR^2 can be found by a preliminary run and then the above torque applied for a final test.

To take an actual example from practice: Diameter of shaft is 1⅞ inches; diameter of cord is .084 inches; applied weight is 7.6 pounds. Radius of applied torque is then .9375 + .042 = .9795 inches = .0816 feet.

The weight used and therefore the force applied

Method of determining inertia of a rotor with cord and weight. Calculations are based on a radius of unity

at this radius is 7.6 pounds. The equivalent force at 1 foot radius is 7.6 × .0816 = .621 pounds. The actual acceleration of the descending weight can be figured from known time of fall and distance by the formula

$$S = \frac{1}{2} at^2$$

Solving this for a from readings taken for the time of fall for each foot gives an average acceleration of .02073 ft./sec.^{2}. A point on the rotor at one foot radius would then have an acceleration of .02073/.0816 = .254 ft./sec.^{2}

Taking the fundamental equation

$$F = ma \text{ or } F = \frac{W}{g} a$$

and substituting the equivalent force and acceleration at one-foot radius

$$W = \frac{gF}{a} = \frac{32.2 \times .621}{.254} = 78.7 \text{ pounds}$$

and, since a and F have been converted to one-foot radius, this will be the WR^2 of the rotor.

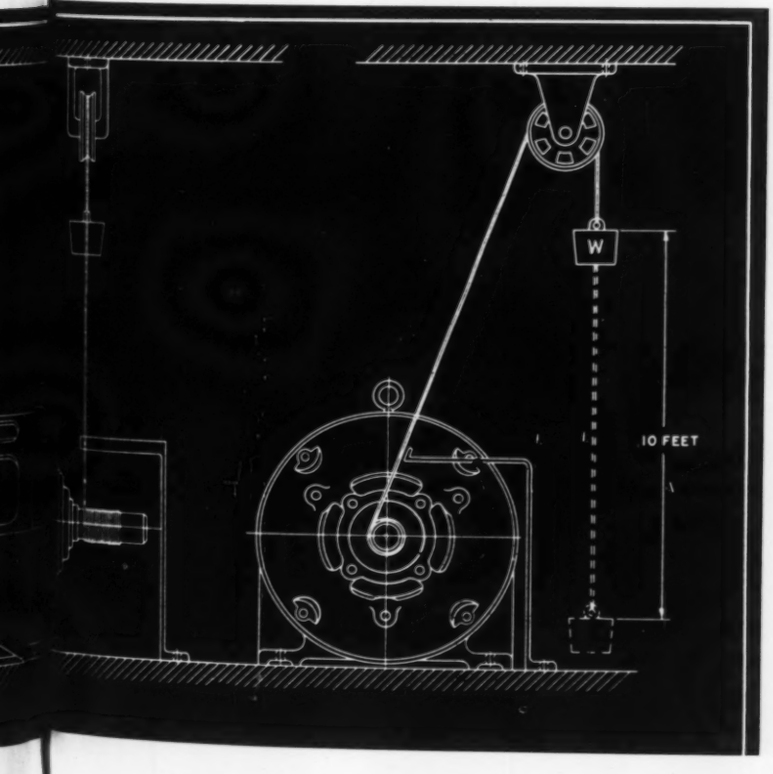
As a check on the above, equating the kinetic energy to the stored energy gives substantially the same value for W.

With a 10-foot fall at a uniform acceleration of .0205 ft. per sec.^{2} (calculated from a measured time of 31.2 seconds for a 10-foot fall of W), the final speed will be $V = at = .0205 \times 31.2 = .641$ ft. per sec.

On the rotor this velocity is at a radius of .0816 feet. At one foot radius the velocity will be .641/.0816 = 7.87 ft. per sec. and the stored energy is $10 \times 7.6 = 76$ ft.lbs. So $\frac{1}{2} m V^2 = 76$ and $m = 76 \times 2/(7.87)^2 = 2.45$. Then $W = 2.45 \times 32.2 = 79$.

Having obtained the value of WR^2, the windage and friction losses can be measured by running the machine at top speed and allowing it to coast to standstill taking the speeds at 200 revolutions per minute intervals with a tachometer and the corresponding time with a stop watch. The figure already obtained for WR^2 is used in computing the kinetic energy, and the KW loss may be plotted to show losses due to windage and friction.

The fan energy can be determined by removing the fan and repeating the run and then subtracting the loss so obtained from the previous run with the fan.



Infra-Red Aids Production of Finish

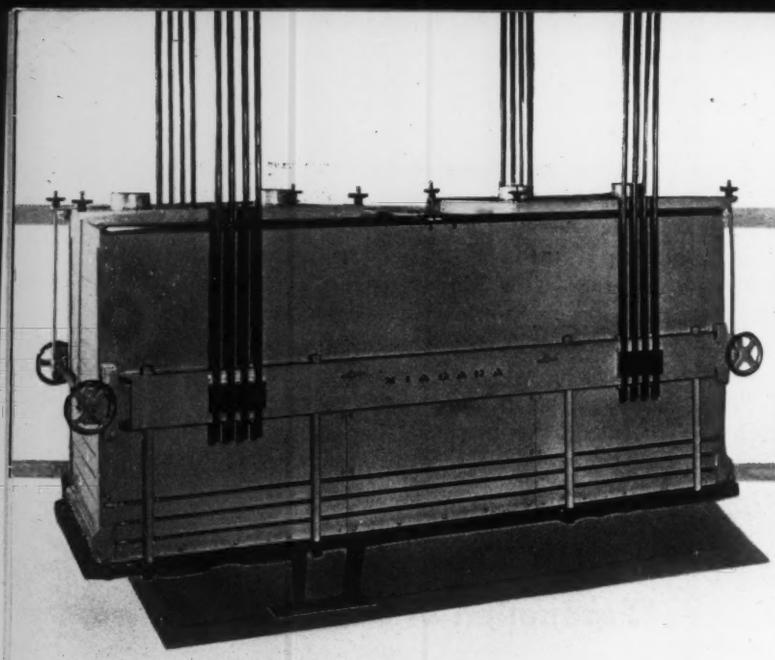
ADVANTAGES and applicability of paint baking with near infra-red were discussed by representatives of Dayton Manufacturing Co., General Electric and others at a recent technical production conference sponsored by New Wrinkle, Inc. It was pointed out that with infra-red equipment baking time has been reduced as much as 90 per cent in some instances as compared with the convection type oven.

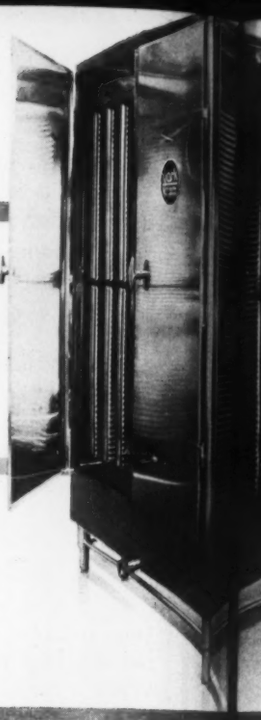
Drying equipment was demonstrated which featured a deep bowl, gold plated reflector designed to project an even spread of intersecting rays. Because of its depth this reflector directs all lateral rays on to the work, keeping "spill' rays at a minimum. Energy from the reflector is controlled in such a manner that a sufficient quantity is directed on to the leading and following surfaces of an object passing on a conveyor through a "tunnel" of directed rays.

Of interest also is a new process of manufacturing a highly satisfactory and improved wrinkle finish without the use of China wood oil. Because this oil has advanced from 12 to 28 cents a pound, the development makes possible wider applications of this type of finish. The new base is Dehydrol, a castor oil product. Another improvement is a new resin, Wrintex, possessing unusual wrinkling characteristics which will facilitate production. The wrinkling vehicle offers economies due to its high viscosity, freedom from checking, uniform appearance on thin coats and an ability to produce a highly satisfactory texture even after an overnight air-dry period.

DISCUSSING the $200,000 industrial progress award program of the James F. Lincoln Arc Welding Foundation, a recently published brochure classifies practically every branch of the industrial field in which entries may be made.

Anyone engaged in the design or execution of work upon equipment involving arc welding fabrication is eligible for one of the 458 awards. As a gage for evaluating papers, the following indicates the scope of treatment: Reduction or elimination of hazards to safety and health through increased strength and durability; greater availability of such advances through lower prices; industrial benefits including savings in cost, time and materials in manufacture, fabrication, construction and maintenance.





York cabinet milk cooler (right) utilizes eighteen-gage stainless steel for practically all parts. Milk distributing troughs at top are completely welded, grooved and drilled to provide equal distribution of milk on both sides of each cooling section. Uniform cooling without freezing during shutdowns is maintained by gravity-feed system

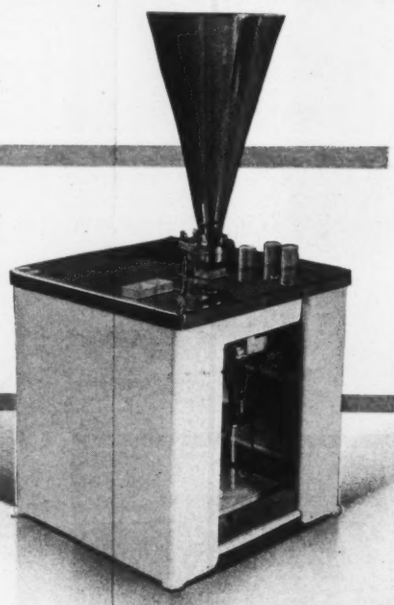
Automatic and mechanically adjustable balance weights of the Richmond Super Sifter (above) are located at the center of gravity and the two wooden reed supports are fastened at exact gravity level. Drive is over adjustable ball bearing idlers from motor above or below to pulley on the vertical shaft carrying the balance weights

Design

IN NEW

(For new machin sting

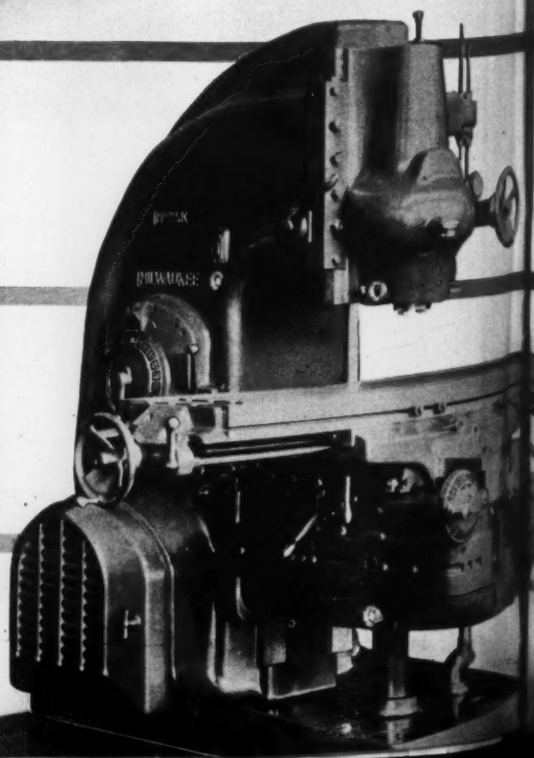
THIS MONTH'S COVE C
provided on Cross double-p dle
gear tooth chamfering and p ting
forced-feed lubrication system ls a
controlling device automatic br
position upon completion of ing
is carried on hardened and rou
assuring a rigid, ctio

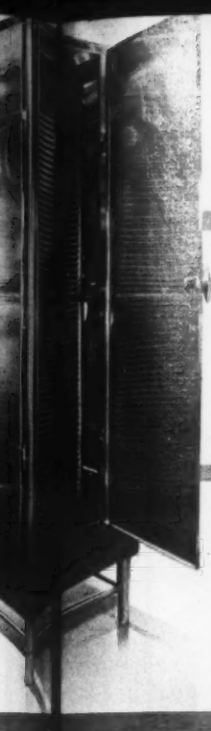


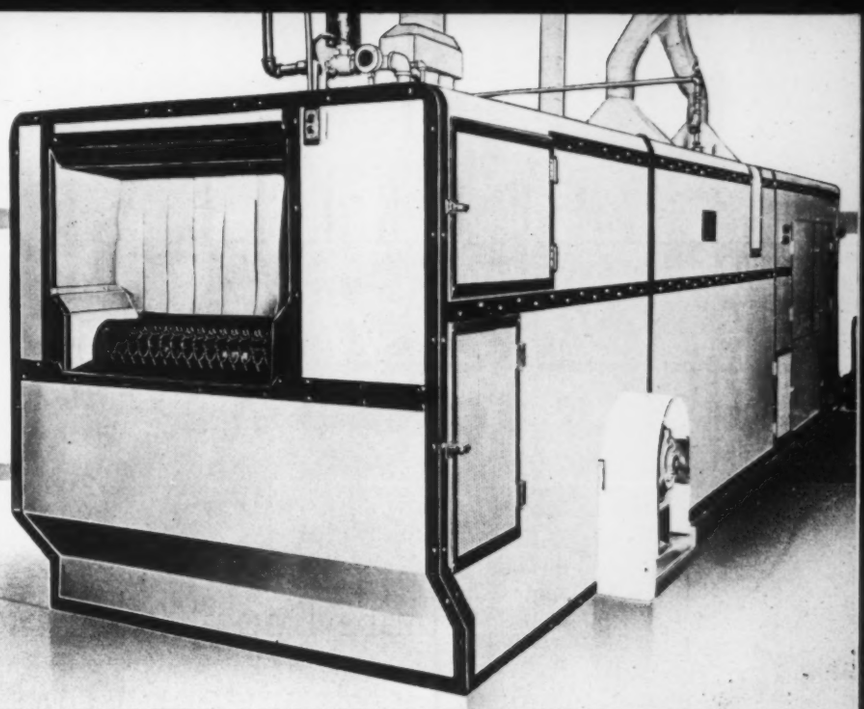
Method of vacuum control incorporated in the valve and head design of the Modern Packaging semi-automatic filler (right) holds weights of liquids to extremely close limit. Dustless filling operation is assured at same time. Machine has capacity of twenty-four containers per minute

Aluminum side rails of the redesigned Heyer duplicator (below) reduce weight. Striping and lettering are raised and polished, balance of side being painted a chocolate brown in crackle finish. Ink control, counting and feeding are automatic. Other white metal parts are heavily chromium-plated. Styled by Barnes & Reinecke, the machine's cabinet blends well with it

Simple lines of solid back column and massive knee of Kearney & Trecker vertical milling machine (right) reflect careful distribution of weight and resistance to strain. Driven through multiple V-belt, the unit has twenty-four speeds and thirty-two feeds. Designers for Industry Inc. collaborated on design of knee section. Controls are arranged to make them part of integrated whole





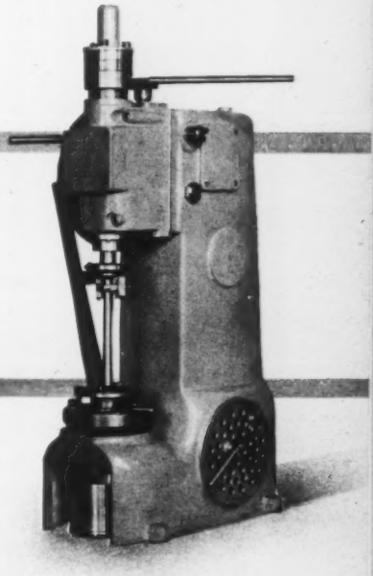


Specially designed air nozzles aid drying by blowing water from pans in the Ross industrial washing machine (right), leaving little water to be evaporated. Spray pipes can be removed without breaking conveyor. Speed reducer permits regulation of speed of baskets through machine. White enameling steel is used for exterior, with all exposed metal trim chromium plated

...ign Features ...W MACHINES

...w machi...sting see page 118)

...COVER... Complete electric control is ...double-...dle machine for index milling, ...g and ...ting operations. Self-contained ...n syste...ls all working parts. An electric ...tomat... brings the machine to loading ...tion of ...ing cycle. Bridge-trussed table ...ned and ...round steel ball bearing gibs, ...a rigid, ...ction-free mounting



Bench model Incolap gear finisher (right) has manual controls for starting and stopping, for lifting gear for indexing and for controlling pressure between gear and lap. Using time clock mechanism and actuating air cylinders, however, provision is made for automatic control of these motions

Motor and glue pan in Whirlwind electric label paster (left) are fully enclosed and heat from the motor is retained and transmitted through the aluminum housing to the glue pan, keeping glue tepid at all times. Stainless steel pickers are specially shaped to repel glue and permit quick removal of lables. Oilless phosphor bronze bushings are used

Constant air pressure in the piston return chamber of the Progressive hydraulic puncher (right) eliminates spring return. During punching stroke hydraulic pressure overcomes the pneumatic, but is released immediately after. Removal of punched part is facilitated by foot-actuated work ejector. Three-way control valve admits oil under pressure to individual punching units

MACHINE DESIGN

Editorial

Future Depends on More and Better Engineering and Research

NONE will deny that this country has taken top rank among nations through scientific achievement, nor that it will maintain its place in the new world order—regardless of how the present crisis results—only by continued emphasis on engineering developments. Whether isolated and facing fierce competition, or as the leader of a relatively small group of democracies, its future course will not be easy. Complacency and self-satisfaction have no standing in a world in which scientific progress (industrial and military) coupled with a "back-to-work" movement, is the only hope for continued peace and prosperity.

That our great industrial companies are capable of such progress is amply typified by the recent opening of a new and spacious engineering and research laboratory by the Chrysler corporation in Detroit. Following only the most advanced practice in design, research, testing and general engineering procedure, this laboratory can without doubt be taken as symbolical of the spirit of advancement becoming increasingly evident among leading manufacturing companies throughout the country.

Not only is this true of large companies; the trend fortunately is general. A recent government survey shows that the number of research workers in diversified industries has grown rapidly during the past few years, and indicates that the progress made by manufacturing companies is related definitely to the amount of money, labor and effort expended on research and development work.

It is reassuring to think that such activity could quickly be turned over to purely military purposes. If and when steps in that direction become necessary, these farsighted organizations can be counted on to do their part. And the more of them there are, the less the likelihood of their being diverted from natural, peaceful growth to the development of equipment for war. Nationally, the fostering of engineering and research is sound, dividend-paying insurance!

New Trim Size

HAVE you noticed the new physical dimensions of MACHINE DESIGN? In the interests of standardization affecting economy, efficiency, ease of handling and filing, a "trim" size of 8¾ by 11⅝ inches has been adopted, effective with the July issue.

Engineers are no strangers to standardization. Without it, engineering and production in general would be in a sorry plight. Therefore we are confident that although some few readers may miss the former wide margins and slightly more open appearance of the editorial pages of MACHINE DESIGN, the all-around advantages of adopting the smaller trim size will be thoroughly appreciated.

Professional Viewpoints

" . . . parts have little distortion"

To the Editor:

REFERRING to your recent article on induction hardening, for nearly two years Packard has been using pearlitic malleable iron camshafts hardened by this method. The surface of the cams and the eccentric are Rockwell C-60 and the integral oil pump gear is Rockwell C-55.

For a longer period of time Packard has been using an induction hardened transmission shaft which has three areas hardened, each to a different hardness, varying from Rockwell C-50 to C-60.

None of these parts so hardened have shown any signs of wear. This record is due to the selection and control of the materials used and to the induction process with its automatic regulation of power and split second heating and quenching times, which makes for uniformity of results.

The induction process is rapid and clean. One operator can harden 60 camshafts or 125 transmission shafts per hour. There is no scale or decarburization, and the part after induction hardening is ready for finish grind, thus eliminating such costly pre-treatments as copper plating, carburizing and cleaning.

The process also has a very desirable quality in that the parts so heat treated have very little distortion, thus saving an expensive straightening operation.

—W. J. KETCHAM
Packard Motor Car Co.

" . . . a distinct contribution"

To the Editor:

I WANT to compliment you on R. E. Orton's series of articles presented in MACHINE DESIGN on photoelasticity. Not only is this series timely but it is particularly useful in that it presents this method of study of stress distribution in a very understandable and usable way. I have used a presentation of this method in a goodly number of talks with engineers, and when they realized it did not involve high powered mathematics, but was simple and usable, they were not only surprised but elated that they could have a means of studying stress distribution easily and inexpensively.

This series of articles is a distinct contribution to the subject, and again I want to compliment you.

—E. W. P. SMITH, Consulting Engineer
The Lincoln Electric Co.

" . . . nominal stress inadequate"

To the Editor:

IN THE May issue of MACHINE DESIGN Dr. Wahl presented the conventional method of considering "stress concentration factors" based on a "nominal" stress. R. E. Peterson, in Timoshenko's "Contributions to the Mechanics of Solids" presents the concept of a "sensitivity" index based on these concentration factors, and attempts to relate this index to the stress gradient, grain size, etc. The writer has found this system inadequate for considering the stress relief in the usual shapes analyzed photoelastically. Moreover, since the index is based on a nominal stress which is after all an arbitrary figure, it would appear that no satisfactory relationship for it could be found.

To bring out this point the following development is given: Let S_n = the nominal stress, S_t = the theoretical stress and S_a = the stress actually developed. The theoretical concentration factor K_t, is defined as:

$$K_t = S_t / S_n \quad \ldots\ldots (1)$$

and is applied in the following way to determine S_t,

$$S_t = K_t S_n \quad \ldots\ldots (2)$$

The "fatigue strength reduction factor," K_f, is defined as the "endurance limit of specimen without concentration" divided by the "endurance limit of specimen with concentration." Since the stress actually developed in the part is assumed to be equal to the endurance limit without concentration, the numerator is S_a. The denominator is obviously S_n. Therefore

$$K_f = S_a / S_n \quad \ldots\ldots (3)$$

The sensitivity index "q" is defined as

$$q = (K_f - 1)/(K_t - 1) \quad \ldots\ldots (4)$$

By means of (1) and (3) Equation (4) may be written as

$$q = (S_a - S_n)/(S_t - S_n) \quad \ldots\ldots (5)$$

That is, q is the ratio of the stress increase over the nominal that actually occurs, to that which is theoretically to be expected. Obviously, since S_n has no real or theoretical meaning, q rests on a fictitious base, and difficulty in correlating data is to be anticipated.

The writer believes that S_n should be forgotten, looking on K_t simply as a correction factor to obtain S_t, where conventional methods of stress analysis are used. He wishes to introduce, instead, the concept of

(*Continued on Page* 102)

Avoid Misunderstandings with Outside Inventors

COMPANIES receive many letters each year concerning ideas and inventions which the writers hope may be of value to the company in its business. While these are sometimes submitted without any thought of compensation, many times the writers believe they have something of value for which they should be paid. Such persons should protect their interests and at the same time, the company approached must protect its interests.

Policies of the General Electric company in this respect may be summarized as follows:

1. The company cannot consider, on the basis of a confidential relationship, any idea or invention submitted to it for purchase. Confidential relationships may create obligations which do not exist where a would-be seller and a prospective buyer are dealing at arm's length.

2. The company cannot consider an idea or invention on the condition that if it is not found of interest, it shall be kept a secret. Not infrequently it may be necessary to refer it to a number of different members of the organization to ascertain whether or not it is of interest. While there may be no intention of giving it any publicity, its secrecy cannot be assured.

3. The company cannot consider an idea or invention on the condition that it shall return any material submitted if the idea or invention is not found of interest. It is necessary that the company be permitted to keep such material so that reference may be made to it if a controversy should unfortunately arise as to just what was disclosed to it. Since the company cannot assume the responsibility of preserving such material and cannot return it, the person submitting it should keep a duplicate for his own record.

4. The company cannot consider an invention on the condition that prior to disclosure of the invention an agreement be made setting forth a basis of compensation for its use.

If a person has an idea which he thinks is a patentable invention and which he desires to submit to the company, it is essential that he make a full disclosure of the invention before any decision can be reached as to whether or not the company is interested in acquiring patent rights. Any of the following three modes of procedure should be sufficient to enable the company to reach its decision:

1. He may file an application for patent, wait until his patent has been granted, and then bring it to the attention of the company.

2. He may file an application for patent and then submit a copy of the patent application to the company for its consideration.

3. He may make a written description and sketches of the invention, signing and dating both the description and the sketches. These should be made in duplicate as heretofore suggested, one of the duplicates being submitted to the company for its consideration while the other is retained for record. In order that he may be in a better position to prove the making of any such written description or sketch, he should consider making a disclosure to some person or persons who can understand the invention and who will sign and date both duplicates as a witness.

If the procedure outlined in the third alternative is followed, it is not necessary for consideration by the company that artistic drawings be prepared; rough sketches are sufficient. Nor is it necessary that any particular phraseology be employed in the description. The important thing is that the description supplemented by the sketches shall disclose the invention so clearly that a person ordinarily skilled in the art to which the invention relates can understand just what the inventor proposes to do and how he proposes to do it. It will be helpful if the inventor will point out what he believes to be new and set forth some of the advantages which he thinks the invention has over known devices or processes.

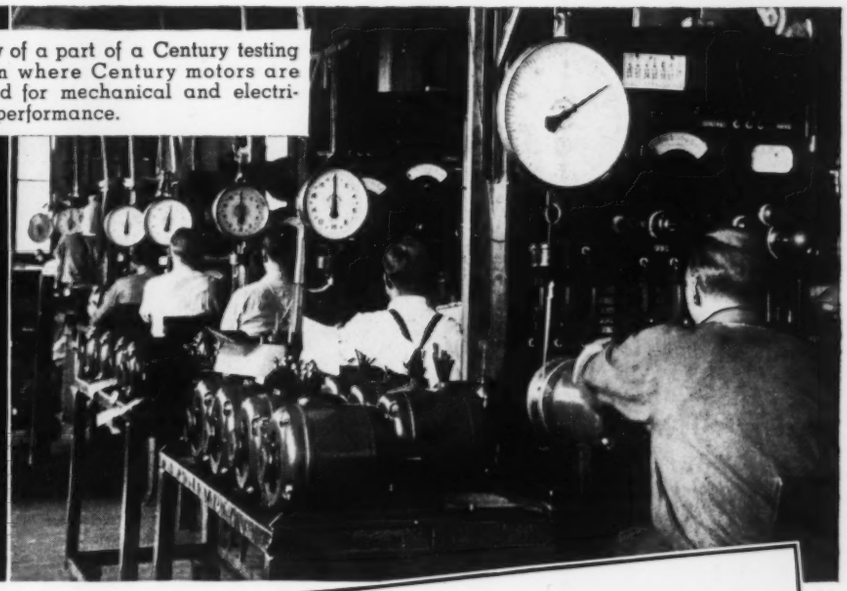
The company wants an inventor to protect himself to his own satisfaction before disclosing any invention to the company.

Any disclosure of an invention to the company must be made with the understanding that the company will give the disclosure only such consideration as in the judgment of the company it merits, and that the company assumes no obligation whatever other than to say whether or not it

(*Concluded on Page* 116)

DIFFICULTIES often are encountered through misunderstandings with outside inventors, as discussed in the article by George V. Woodling in M. D. for June. For this reason a pamphlet on company policies is customarily sent by General Electric to everyone submitting ideas to that organization. These policies are illuminating with respect to outside inventions and confidential disclosures and are given in the accompanying

to Assure Maximum Performance



View of a part of a Century testing room where Century motors are tested for mechanical and electrical performance.

Every Century Motor is Individually Tested at the Factory

Because of Century's strict adherence to the highest standards of precision manufacture of fractional horsepower motors, you are assured that every Century Motor will operate economically and satisfactorily on any job for which it has been designed and recommended.

They are built to the same high electrical and mechanical standards as are incorporated in the integral horsepower sizes of industrial power motors.

To make sure that the motors you buy conform to the highest standards set by Century's engineers, every motor undergoes an individual brake horsepower test before it leaves the factory. Century Motors are "run in" and tested under full load and maximum load conditions and given AIEE and NEMA dielectric tests. And all Century fractional horsepower motors are checked for quietness.

Thorough testing at the factory including individual final checking is only one of many examples of why Century Motors offer you the type of performance that is setting new standards for motor driven appliances and industrial equipment.

In addition, Century's wide range of kinds, types and sizes of motors, from fractional to 600 horsepower, assures you of the *correct* motor to meet the characteristics, requirements and surrounding conditions of practically any application.

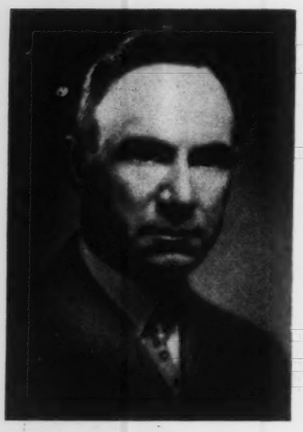
To find out more about the advantages of Century Motors for your specific applications, call in your nearest Century Motor Specialist. He's in the field to be of service — his years of experience will prove valuable to you and your engineers.

CENTURY ELECTRIC COMPANY
1806 Pine Street St. Louis, Mo.
Offices and Stock Points in Principal Cities

Century MOTORS

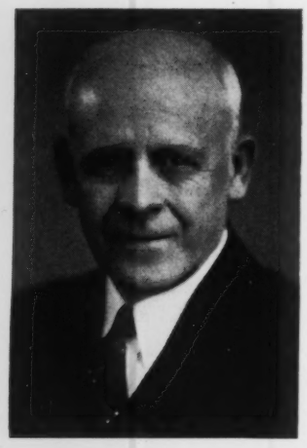
One of the Largest Exclusive Motor Manufacturers in the World

Men of Machines



NOMINATION of William Andrew Hanley, mechanical engineer and business executive, for the office of president of the American Society of Mechanical Engineers was announced at a recent meeting. Mr. Hanley was born in Greencastle, Ind., in 1886, and was graduated with a mechanical engineering degree in 1911 from Purdue university which twenty-six years later bestowed upon him the honorary degree of doctor of engineering. Previous to attending Purdue Mr. Hanley was employed by Republic Steel Corp. and the Broderick Boiler Co. Upon graduation he joined Eli Lilly & Co., of which he is today a director and head of the engineering division. This division designs and supervises all engineerng projects for the company. Mr. Hanley has been active in the affairs of the society since 1913 and has contributed a number of articles on both engineering and economic subjects to the technical press.

W. A. HANLEY



APPOINTMENT of Ivan C. Crawford as dean of the school of engineering and architecture, University of Kansas, has recently been made. Dean Crawford graduated from the University of Colorado in 1915, following which he worked in various engineering positions with the Illinois Central railroad., Oregon Short Line, and Denver and Rio Grande railroad. He then became instructor and later assistant professor and professor at the University of Colorado. In 1923 he was appointed dean of the college of engineering, University of Idaho and also filled the position of director of the Idaho Engineering Experiment station. On leave from this university, he worked as state engineer for Idaho Federal Administration Public Works. He went to his new post at University of Kansas upon leaving Idaho university. The new dean was born June 2, 1886 in Leadville, Colo.

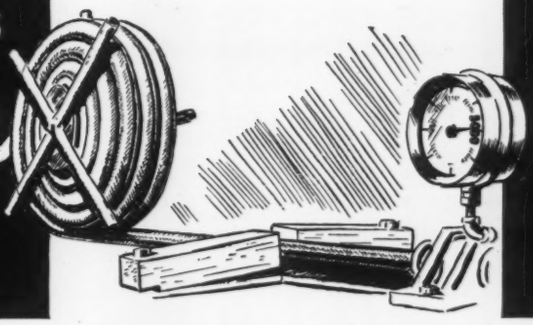
IVAN C. CRAWFORD

WELL known in automotive and aviation circles, Paul Klotsch has been appointed chief engineer of the automobile division of The Crosley Corp., Cincinnati. For the previous five years he was connected with Briggs Mfg. Co. in its experimental engineering department. There he was in charge of the design of automobiles with engines mounted in the rear, also engines and chassis design. Another phase of his automobile engineering work was on aircooled engines, independent wheel suspension and other new types of automotive design and construction.

The design and development of the 175-passenger airplane projected by General Development Co. of New York in 1930 was one of Mr. Klotsch's outstanding aviation achievements. Prior to this connection he was employed by Chance-Vought Corp., builders of naval aircraft. He has also done development work on internal combustion engines and conducted

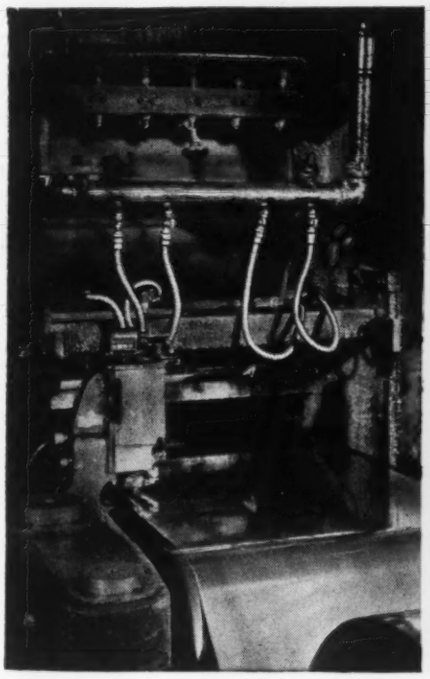
PAUL KLOTSCH

AS FLEXIBLE AS *Garden Hose*

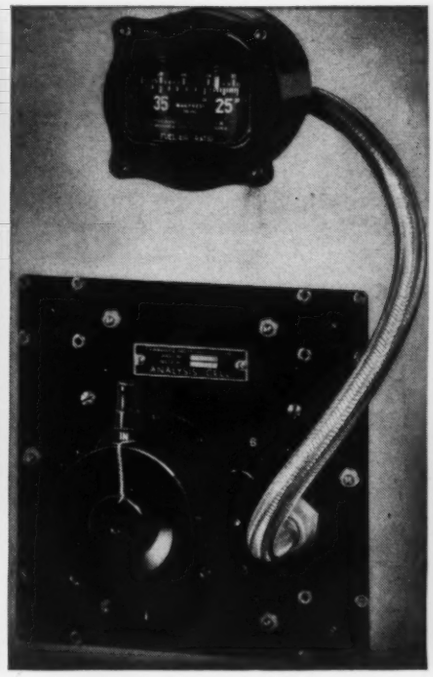


AS STRONG AS **RIGID PIPE**

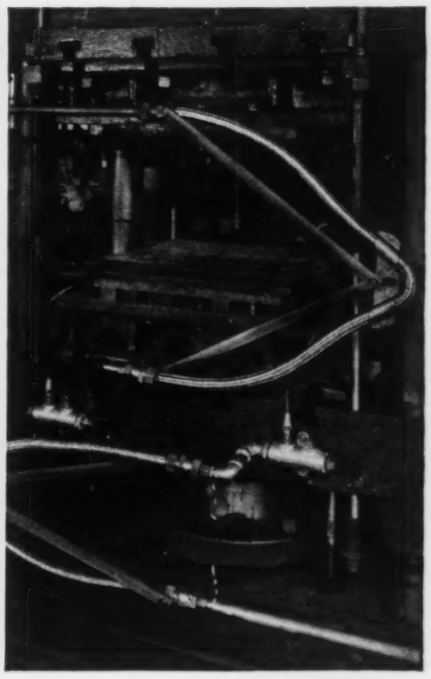
FLEXIBLE METAL HOSE



This use of American Seamless Flexible Metal Tubing comes under the heading of "tremendous trifles." It conveys coolant under pressure to the strip as it comes out of this giant rolling mill. But, insignificant as the flexible tube sections appear against this colossal background, their service must be dependable under rigorous operating conditions. Tough, hard-bitten American Seamless is always on the job —protecting operating profits.



Without shielding conduit, wires of airplane instruments would be a natural path for radio frequency disturbances. So, instrument designers look to resourceful flexible metal hose for the solution, and invariably they find the right answer. Shielding conduit is ordinarily made in aluminum in all sizes up to 2½" I.D. There are many other special jobs that flexible metal hose can undertake economically. Let's have the details of your problem.



Instead of pipe and swing joints that leak, waste steam and require frequent repacking, makers of hydraulic presses use American's patented "Bracketube." It is designed to convey steam or water to the movable platens of steam heated molding presses. For connecting moving parts, American Seamless brings the unmatched advantages of pressure-tightness, toughness and an ability to be flexed millions of times without breaking down. 40249

These and hundreds of other design problems involving flexible metal connectors in the conveyance of steam, air, oil and other liquids and gases have been solved by the products of American Metal Hose. The book illustrated will bring you complete and detailed information on American Seamless, the most dependable flexible metal tubing you can specify.

ANACONDA

American Metal Hose

AMERICAN METAL HOSE BRANCH, THE AMERICAN BRASS COMPANY
General Offices: Waterbury, Conn. Subsidiary of Anaconda Copper Mining Company. In Canada: Anaconda American Brass Ltd., New Toronto, Ont.

Standing for solidarity

By what basic methods have "Allens" stood solid in the preference of design-engineers through three decades?

(1) By *cold-drawing* of sockets, to increase the density of the steel in the socket-walls;

(2) By *pressur-forming* of cap screws, to preserve continuous (uncut) steel fibres shaped to the contour of the screw head;

(3) By *precision-threading* of set screws on lead screw threading machines; by *duo-process* threading of cap screws, to make the axial fibres of the steel conform to the contours of the thread profile;

(4) By *heat-treating* individually according to size and style of point, to correctly balance the hardness and toughness in the right ratio for 95% of all uses;

(5) By *instrument-testing* at every step, for each physical characteristic, with final hand-and-visual inspection of every screw.

We leave to you the interpretation of these operations in terms of *HOLDING POWER* of the product. So briefly stated, they're merely clues — worth following with your request for *free samples* — leading surely to SOLIDARITY in your machine assemblies.

Your local Allen Distributor will oblige with samples and SERVICE.

THE ALLEN MANUFACTURING COMPANY
HARTFORD, CONN., U. S. A.

studies and experiments with oil burning characteristics of diesel engines as engineer in charge of the research laboratory of the Fuel Oil Motors Corp., New York. From the foregoing it may be seen that Mr. Klotsch is ably fitted to fulfill his duties as chief engineer of the automobile division of The Crosley Corp.

♦

GEORGE H. FREERS has recently been added to the engineering staff of Marmon-Herrington Co.

♦

E. E. BRACKETT, head of the agricultural engineering department, University of Nebraska, has been nominated as president of the American Society of Agricultural Engineers.

♦

FREDERICK FULFORTH, since 1930 in charge of plating and polishing departments of Proctor Electric Co., a division of Proctor & Schwartz Co., has been elected president of American Electroplaters' Society.

♦

LINCOLN T. WORK has been made director of research of the Metal & Thermit Corp., New York. Prior to his new appointment he was associate professor of chemical engineering at Columbia university. All the corporation's research and development activities will be under his supervision.

♦

GEORGE M. MCGRANAHAN, assistant chief engineer at The Dow Chemical Company's Midland plant, has been transferred to Freeport, Tex., to become director of production engineering.

♦

HENRY BOOTH has been elected president of the International Acetylene association for 1940. Mr. Booth is now vice president of Shawinigan Products Corp. of New York.

♦

CHARLES J. MCCARTHY, who has been connected with Vought Sikorsky Aircraft Division of United Aircraft Corp., East Hartford, Conn., in various engineering capacities, has become general manager of the division. Mr. McCarthy joined the Chance Vought Aircraft company as executive engineer in 1926, was made chief engineer in 1930, and became engineering manager in 1935. In 1937 he was named assistant general manager, retaining this position when Chance Vought and Sikorsky were consolidated to become the Vought-Sikorsky Aircraft Division in 1939.

♦

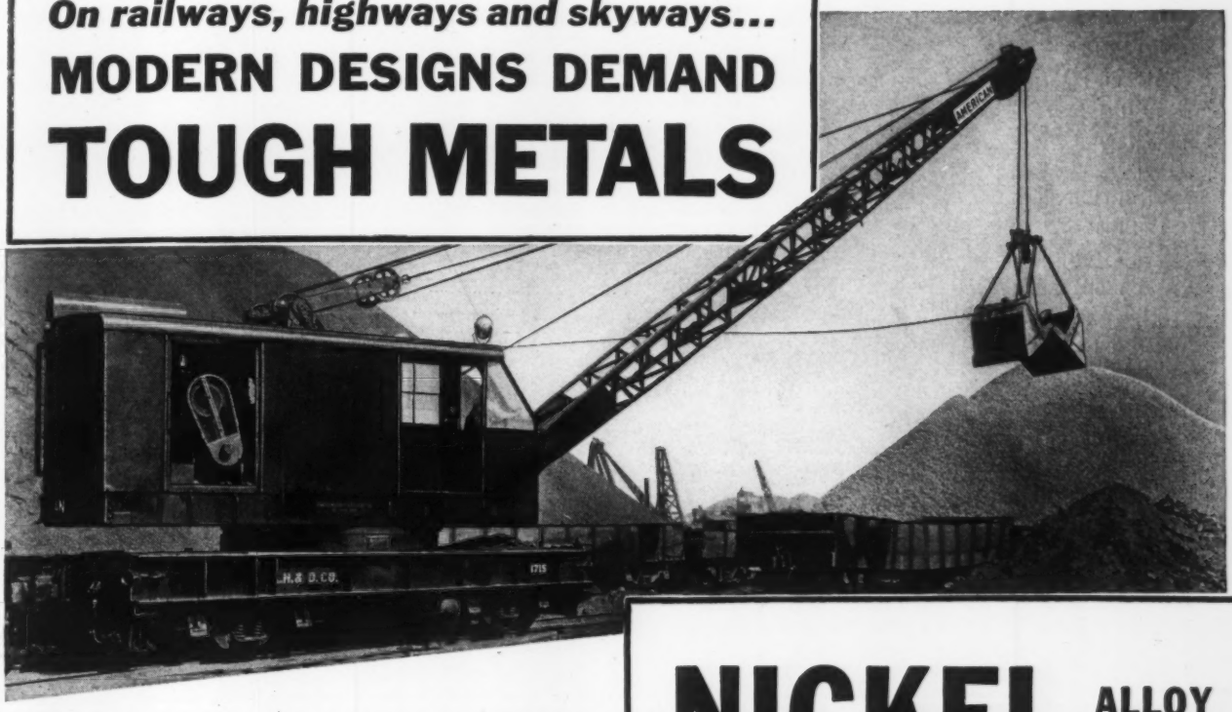
STEWART E. LAUER was elected president of the Air Conditioning Manufacturers' association during its recent meeting. Mr. Lauer is president of the York Ice Machinery Corp.

♦

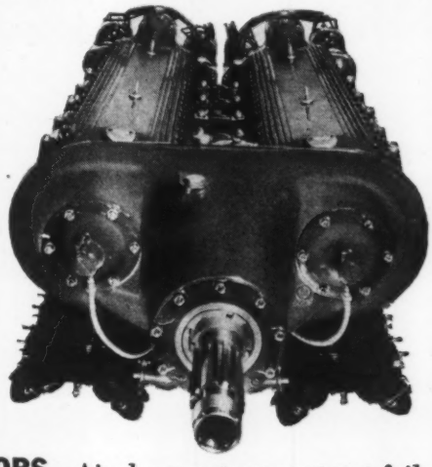
J. Y. DAHLSTRAND, who has for the past two years has been chief engineer of Universal Gear Corp., has been made director of sales and engineering for the corporation. He had previously been in engineering and sales capacities with Murray Iron Works Co., Kerr Turbine Co., Westinghouse Electric & Mfg. Co., and Allis-Chalmers Mfg. Co.

On railways, highways and skyways...

MODERN DESIGNS DEMAND TOUGH METALS

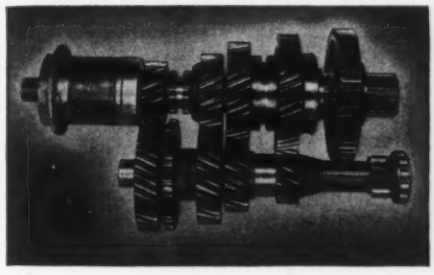


CRANES—Whether you build cranes, planes or truck transmissions, 1940 competition demands efficient, compact designs. Such designs are economically practical when you specify tough, long wearing Nickel alloy steels for stressed units. This modern locomotive crane manufactured by the American Hoist & Derrick Co., St. Paul, Minn., utilizes Nickel steels with tensile strengths up to 115,000 lbs. per square inch for stressed shafting, gears and pinions.



MOTORS—Airplane motors must not fail, so the Menasco Manufacturing Co., Los Angeles, Calif., assure dependability in their "Unitwin" motor by using tough, strong, long-serving Nickel alloy steels for all important parts. The new "Unitwin" consists of two separate in-line engines, generating 325 h.p. apiece, geared to drive a single propeller. The "Unitwin" is used in Vega six place "Starliner" planes.

NICKEL ALLOY STEELS



TRUCK TRANSMISSION PARTS

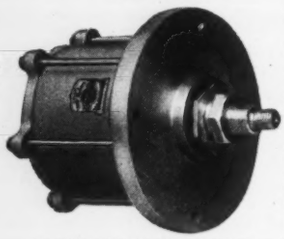
must withstand rough usage and abuse in service. Therefore, the manufacturers of the heavy duty transmission illustrated here, The Four Wheel Drive Auto Co., Clintonville, Wisconsin, specify Nickel alloy steels to assure safe extra strength and toughness in light weight stressed parts. This transmission is especially designed for heavy duty four-wheel drive service, having a torque capacity in excess of the largest engines available.

➡ Heat treatable, readily machinable steels containing Nickel may enable you to simplify design and speed up production. Our suggestions are based upon the practical experience of many plants. For information, without obligation, please address:

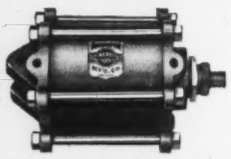
THE INTERNATIONAL NICKEL COMPANY, INC.
67 WALL STREET
NEW YORK, N. Y.

BETTER CYLINDERS *mean* BETTER USE OF AIR POWER

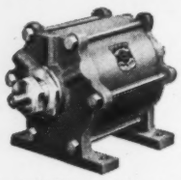
16 in. x 7 ft. honed cylinder



Model JR double-acting pneumatic cylinder



Model BR double-acting pneumatic cylinder



Model CR double-acting pneumatic cylinder

Two features of Hannifin Pneumatic Cylinders provide for better performance—and maximum usefulness from air power.

Hannifin Pneumatic Cylinders, including even the largest sizes, are bored and then honed on special long stroke honing machines. The cylinder bore thus produced is straight, round, perfectly smooth—assuring better cylinder performance, minimum friction loss, and long life.

Hannifin "Leakproof" design provides for simple outside adjustment of the piston packing for easy maintenance of high efficiency piston seal.

Hannifin Pneumatic Cylinders are built in a full range of standard types, sizes 1½ to 16 in. bore, for any length stroke. Both single and double acting types available, with or without air cushion. Write for Bulletin 34-MD with complete descriptions of all types.

HANNIFIN MANUFACTURING COMPANY
621-631 South Kolmar Avenue • Chicago, Illinois

HANNIFIN
PNEUMATIC CYLINDERS

Noteworthy PATENTS

Hydraulics Control Governor

CONTROLLING diesels to operate at constant speed involves sensitive governor design. To vary the fuel supply in accordance with changing loads and speeds yet limit the maximum load taken by the engine is the purpose of the governor shown in *Fig.* 1. Designed by K. O. Keel and C. H. Fike, features of the governor are covered by patent 2,179,696 and assigned to General Motors Corp.

Shown in position for operating at normal speed and carrying about half load, pilot valve plunger and pilot valve bushing are centered. If load is increased, flyweights move inward and the valve plunger moves downward uncovering closed port. Pressure oil then flows to servo-motor pushing its piston upward which by connection not shown increases the fuel supply to the engine.

Upward movement of a compensating piston in the motor creates a pressure forcing pilot valve bushing

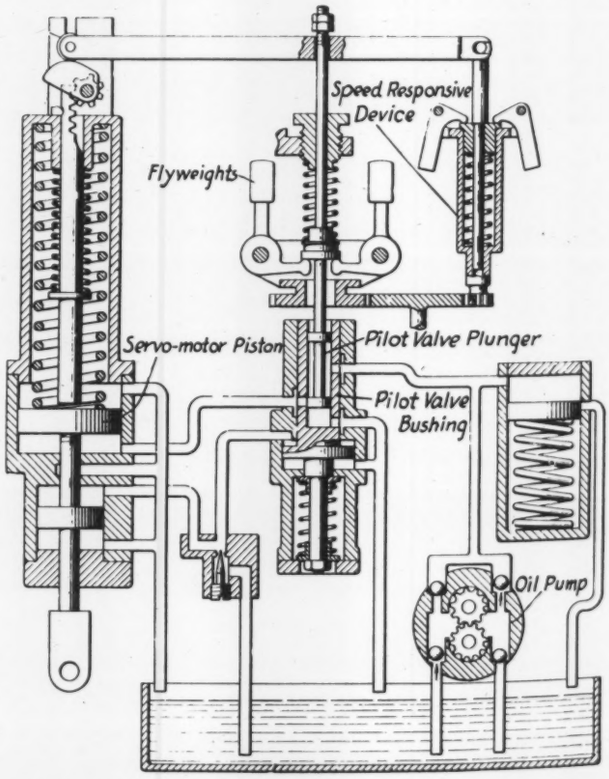


Fig. 1—*Governor maintains constant engine speed during varying loads as well as limits maximum load for each speed*

ROOM TO SPARE IN THIS NEW STARTER!

● Just look at those concentric knockouts in top, bottom, sides and back!

See that screw in the key hole at top? Just loosen (but do not remove) it – then loosen two screws (not shown in picture) in the forked bottom mounting feet, and the entire assembly lifts out. That makes it easy to wire, and there's oodles of space to tuck the wires neatly back into the cabinet and slip the mounting plate into position.

And what a honey of a Starter this is! Double-break, entirely visible silver-to-silver contacts.

Non-carbonizing arc shield withstands high temperature.

Enclosed Thermal Relays of solder pot type, with adequate time lag to prevent unnecessary tripping.

Hinged armature vertical lift magnet.

"3C" BULLETIN 6013
SIZE DS-1

• R A T I N G •

VOLTS	Maximum H. P.	
	1 Phase	3 Phase
110	1½	3
220	3	5
440	5	7½
550	5	7½

AVAILABLE

FORM MA (pictured) with overload reset button in cover. Separate pilot device required.

FORM MB with "MANUAL-OFF-AUTOMATIC" switch and reset button in cover.

FORM MC with "START" and "STOP-RESET" button in cover

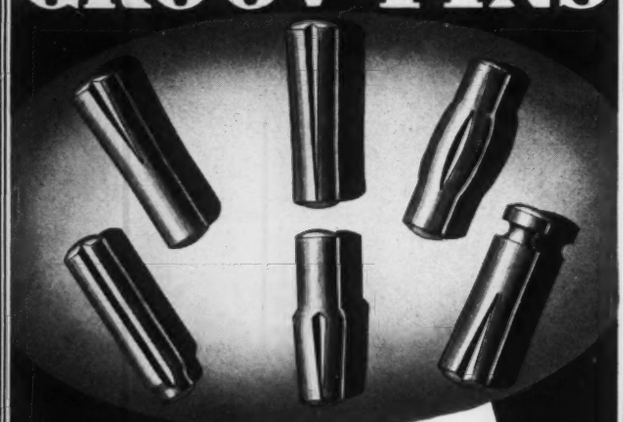
WRITE FOR FULLY DESCRIPTIVE BULLETIN 6013, SIZE DS-1

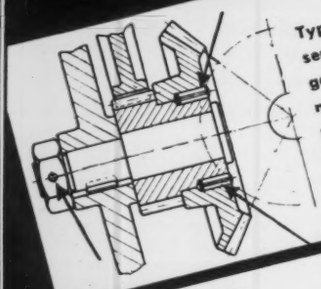
OFFICES IN PRINCIPAL CITIES

THE CLARK CONTROLLER CO.

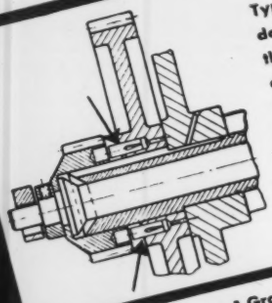
1146 EAST 152ND ST. CLEVELAND, OHIO

GROOV-PINS

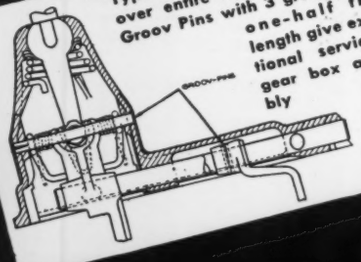




Type 3 Groov Pins serving as union for gear wheels. Permanent, equal holding power over entire length of pin. Unequalled, efficient fastening.



Type 4 Groov Pins as dog clutch pins with three grooves over one-half their length. Serve as stop, dowel, support or hinge pins in blind holes. Outstanding fastening efficiency.



Type 1 Groov Pins with 3 grooves over entire length and Type 4 Groov Pins with 3 grooves over one-half their length give exceptional service in gear box assembly

SAVINGS
Groov Pins require only straight drilled holes. No tapping, no reaming or attendant tool and labor costs.

PRODUCT IMPROVEMENT
Groov Pins have many times the holding power of standard and taper pins. They hold through the life of the assembly—withstanding excessive vibration.

MODERNIZE YOUR ASSEMBLIES FASTENING

Modern fastenings shown above are typical Groov Pin uses. Permanent holding power, secured and maintained the full length of the pin contact surface, combined with lowest costs make Groov Pins unsurpassed for modern assembly fastening.

Modernize assemblies fastening with Groov Pins. Let our engineers help you with your fastening problems.

Send for illustrated text book.

GROOV PIN CORPORATION
411-13 Kerrigan Ave. Union City, N. J.

downward until the uncovered port is again closed. Power piston stops at the exact position required to supply sufficient fuel to sustain the increased load. Flyweights regain normal position, returning plunger.

Cycle of operation for decrease in load is the reverse of that discussed. As the pilot valve plunger is moved upward by outward movement of the flyweights, the port supplying the motor is again uncovered, but below the valve disk. This action bleeds oil from the motor chamber and the motor spring moves downward decreasing the fuel supply.

Speed responsive device is driven at increased speed over that of the governor head. Changes in speed operate a floating linkage between governor and motor. A cam operated by the motor piston controls the position of one end of the floating link. Shape of this cam determines the limit of load for a given speed.

Corrects Errors in Gage

TO COMPENSATE for errors from temperature change and those from variations in characteristics of the mechanism, a bimetal linkage is incorporated in the diaphragm pressure gage, *Fig.* 2. This compensating device is capable of being adjusted to correct the error curve, thereby providing a fully calibrated device.

Upon variations in temperature the diaphragm changes its modulus of elasticity whereby equal changes in pressure under varying temperature will

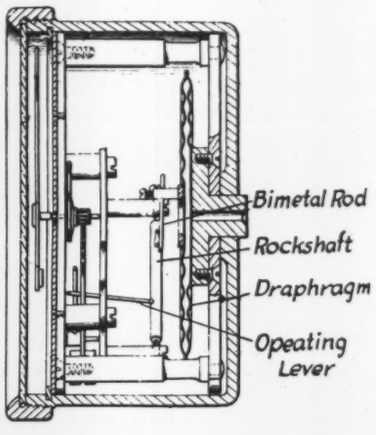


Fig. 2—Bimetal rod is adjusted by rotation to compensate for errors due to temperature in pressure gage

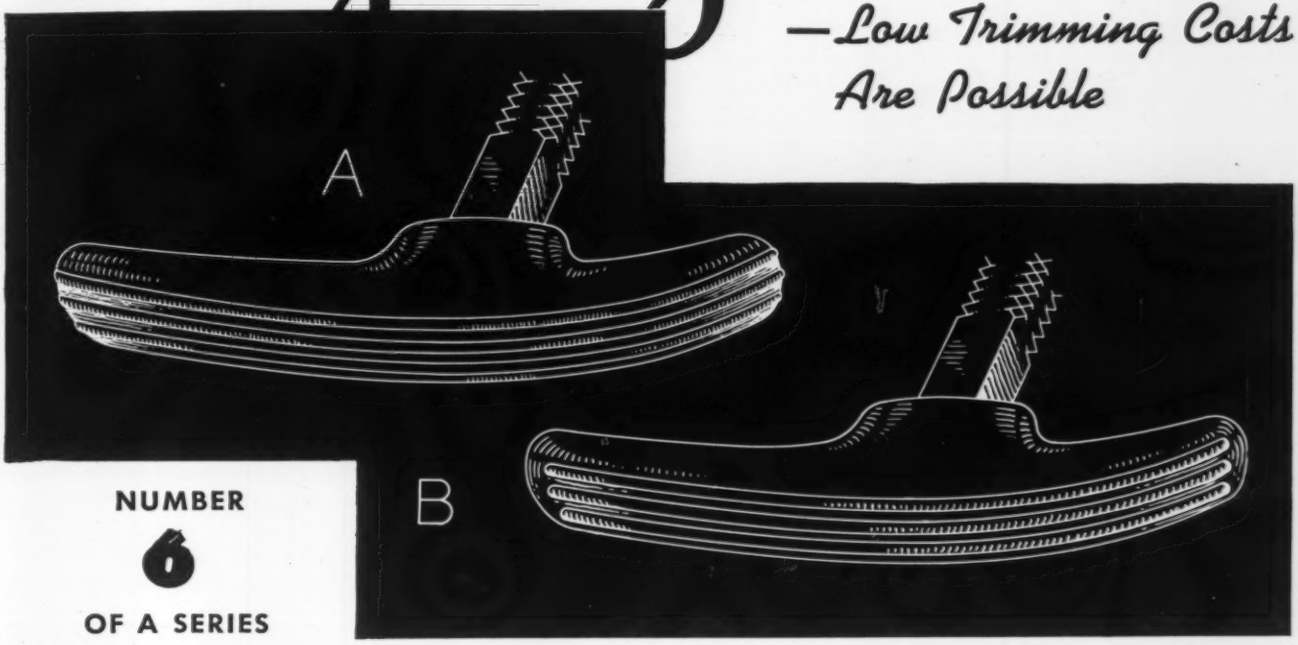
actuate the diaphragm to a different extent. To apply compensating corrections a bimetal rod is mounted in a post on the central part of the diaphragm. This rod is half-round brass welded to a similar piece of Invar.

Contacting this rod is a rod on a rockshaft sufficiently long to maintain contact throughout any arc of the bimetallic rod. Above the fulcrum of the rockshaft is a lever for operating the indicating dial.

By proper choice of effective length, cross section and material of the bimetal rod, by mounting it parallel to the rockshaft and by rotating the rod, the correction curve of the compensator is made to combine with the error curve of the instrument. This device, designed by G. A. Titterington, Jr., is covered by patent 2,194,624 and assigned to Bendix Aviation Corp.

Designing FOR DIE CASTING

—Low Trimming Costs Are Possible



NUMBER 6 OF A SERIES

In designing for ZINC Alloy Die Casting, it is well to remember that removing the gate and the flash at the parting line can represent a considerable portion of the cost of the finished part—consequently the designer should take every precaution to make this operation as simple as possible.

The trimming of irregular or uneven edges is more costly than when the edges are plain. Therefore, when a casting embodies an ornamental design, the irregular section should fade out or stop short of the edges of the die casting. Otherwise it is quite likely that the casting must be trimmed by hand, which ordinarily costs much more than machine trimming.

Figure A shows an example of poor design because the ornamentation was permitted to extend over the ends of the handle. This condition can be corrected—as illustrated by Figure B—by having a design that stops short of the ends.

This is the sixth advertisement in a series appearing currently in these pages covering the major factors involved in "Designing for Die Casting." A new book bearing this title may be obtained from any commercial die caster—or by writing to

THE NEW JERSEY ZINC COMPANY, 160 Front Street, New York City.

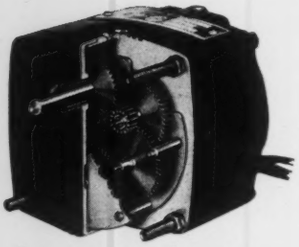
SEND FOR YOUR COPY

ZINC ALLOY DIE CASTINGS

The Research was done, the Alloys were developed, and most Die Castings are made with

HORSE HEAD SPECIAL (99.99+% Uniform Quality) ZINC

A midget capacitor motor with built-in speed reducer



Cutaway view of spur gear reducer on the Type K motor.

Here's a new, small but rugged built-in spur gear speed reducer motor, designed especially for continuous duty on instruments, timing mechanisms, and various control apparatus requiring exceptional reliability. Available in synchronous or non-synchronous capacitor models, in speeds from one to 300 rpm and torques from ⅓ to 120 inch-ounces. The motor develops from 1/750 to 1/2000 hp.

The Type K motor is not a "toy" motor. It has no "permanent" magnet and no internal switches or brushes. It has distributed windings, a high starting torque, and can withstand stalling indefinitely. The unit is fully enclosed to provide complete protection. Write, Bodine Electric Company, 2258 W. Ohio St., Chicago.

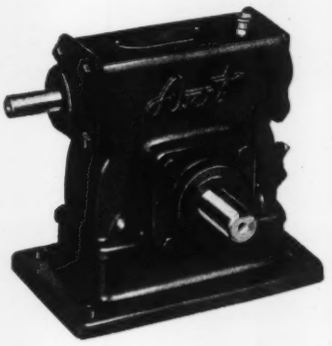
SEND FOR NEW BULLETIN

BODINE MOTORS
ENGINEERED FOR YOUR PRODUCT

New PARTS AND MATERIALS

Lubrication Special in Speed Reducers

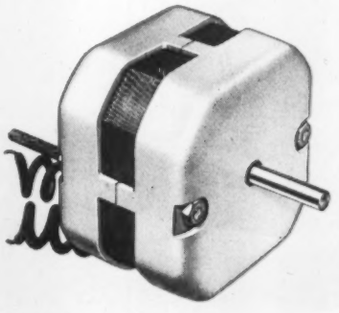
TO SUPPLEMENT its line, Abart Gear & Machine Co., 4832 West Sixteenth street, Chicago, has developed a new intermediate line of worm gear speed reducers designated Type 2⅝ A. Units weigh 22 pounds and are capable of handling inputs from ¼ to 2-horsepower at 1800 revolutions per minute and ⅛ to 1½-horsepower at 1200 revolutions per minute. Ratios range from 4 5/6 to 1 to 100 to 1. Special attention has been given the problem of lubrication. Oil seals are used on both input and output ends to eliminate all danger of oil leakage. To compensate for "build-up" of internal pressure while in operation a breather cap installed on top of the gearcase is provided. Gears, wheel and worm, are assembled in a semisteel, oil tight housing with bearing supports for both worm and worm wheel machined in one casting, insuring absolute permanent alignment, eliminating split bearings and shims.



Intermediate line of worm gear speed reducers has a breather cap on top of gearcase to compensate for build-up of internal pressure

Rate Motor to Hundredth-Horsepower

A FOUR-POLE shaded pole motor, No. 800, is announced by Electric Motor Corp., Racine, Wis. Totally enclosed to adapt it for use in moist or dust-filled atmospheres, the unit is available in ratings up to 1/100-horsepower, sixty cycle. The motor operates on 6 to 220 volts alternating current. Direction of rota-

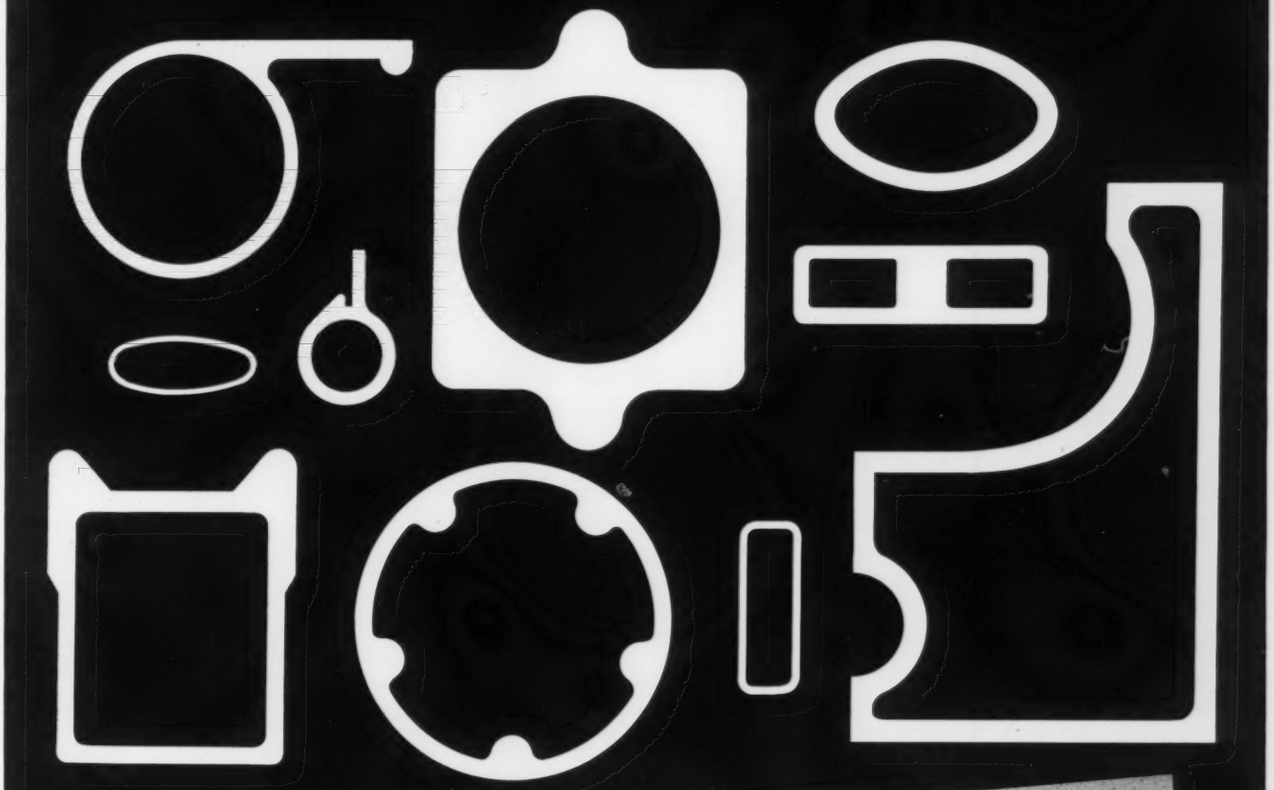


Totally enclosed to adapt it for use in moist or dusty atmospheres, shaded pole motor is on market

MAZLO
Reg.U.S.Pat.Off.

MAGNESIUM ALLOYS

THE LAST WORD IN LIGHTNESS



You can do things with MAZLO HOLLOW EXTRUSIONS

MAZLO hollow extrusions offer great possibilities to the designer. He can get the ultimate in lightness, while keeping a high degree of strength and sturdiness. Metal is placed exactly where it's needed; no wasteful excess.

MAZLO hollow extrusions greatly reduce manufacturing costs. Made to match the desired form quite closely, very little finishing is required. Contours not possible by other methods of manufacture are produced without expensive machining, fitting and assembly operations.

Various MAZLO Magnesium Alloys are recommended for production by this process, giving you a range of characteristics from which to choose. Dies for hollow extruded shapes are not expensive. Maybe we can help you on your problems. Sales Agent: Aluminum Company of America, 1703 Gulf Building, Pittsburgh, Penna.

MAZLO

AMERICAN MAGNESIUM CORPORATION

WHEN UNIVERSAL CAMERA CORP. produced the first molded camera on a large volume scale in this country they used Textolite housings for its light weight, appearance, durability and permanently lustrous finish. More than six million cameras were sold. So it was natural that Textolite would again be used in the new Univex Uniflash for the housing, body, film track, lens mount and flash gun housing. Again Universal got the product they desired.

G-E offers laboratory, engineering, designing and manufacturing services with plants in Pittsfield, Lynn, Meriden and Fort Wayne. Like Universal Camera Corp., you, too, may benefit from Textolite and G-E facilities in your product. For further information write Section B-90, General Electric Company, One Plastics Ave., Pittsfield, Massachusetts.

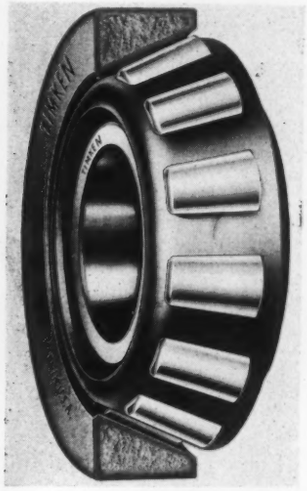
GENERAL ELECTRIC

PD-501

tion is clockwise or counterclockwise. Idling speed of the rotor is 1600 revolutions per minute.

Bearings Handle Large Thrust Loads

PRODUCTION of a new series of the standard SS type bearing is announced by the Timken Roller Bearing Co., Canton, O. The first bearing in this series has a cone bore of 3 inches, outer diameter of 6⅜ inches and width of 1$\frac{13}{16}$ inches. At 500 revolutions per minute this bearing has a radial capacity of 6255 pounds and a thrust capacity of 8710 pounds. These series in addition to those now available in the SS type

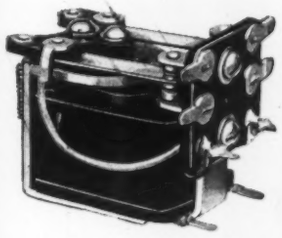


Bearing series is designed primarily to handle those loading conditions where thrust loads are large compared to radial loads

provide a wide range of capacities, varying in cone bores from ¾-inch to 12½ inches. Single-row bearings with steep cup and cone angles, the SS series are designed primarily to handle those loading conditions where thrust loads are large compared to the radial loads.

Midget Relay Free from Hum

HIGH direct current efficiency, "hum-free" alternating current operation and a wide range of coil voltages are noteworthy characteristics claimed for a new midget relay announced by Advance Electric Co., 1260 West Second street, Los Angeles. Where some



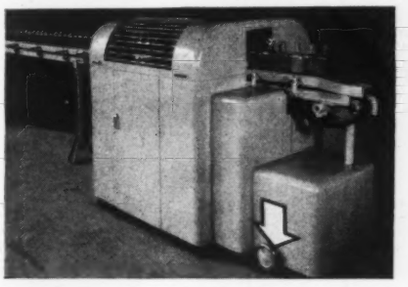
Wide range of coil voltage and freedom from hum on alternating current are claimed for midget relay

degree of sensitivity is to be desired, positive, dependable service may be attained on as little as .1 watts, with a safe continuous-duty rating of plus two watts on noninductive alternating current loads.

Screw Steels Machine Easily

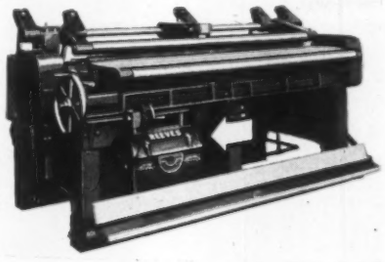
NEW bessemer and new open hearth screw steels with unusual machining qualities are announced by Union Drawn Steel division of Republic Steel Corp., Cleveland. Free from variation in machinability, continuous bars of these steels can be machined at highest

What's New IN VARIABLE SPEED CONTROL APPLICATIONS



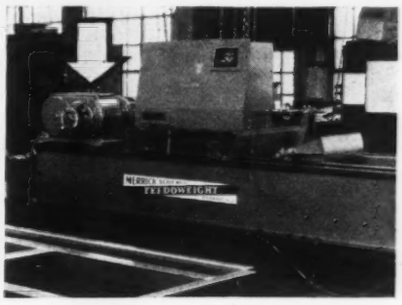
ON BOTTLE CLEANER

In bottling machinery one of the applications of REEVES Variable Speed Control is a Vari-Speed Motor Pulley standardly mounted within the streamlined cabinet of this Automatic Bottle Cleaner manufactured by the Pneumatic Scale Corp., Ltd., North Quincy, Mass. As bottles pass through the machine they are subjected to an internal blast of dry air under 60 lbs. pressure. The Bottle Cleaner is only one of a complete hook-up of machines usually consisting of a Cleaner, Filler, Capper and Labeler. By simply turning the REEVES handwheel, the rate of flow for different sizes of bottles is quickly adjusted to synchronize with speeds of other machines in the line.



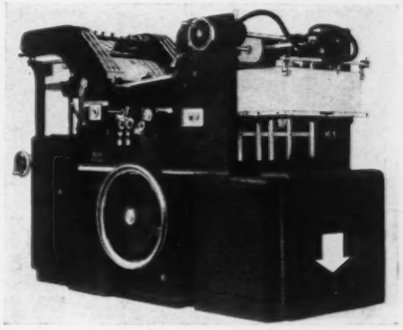
HOSE WRAPPER AND ROLLER

When a great many different sizes, weights or shapes of products must be processed or manufactured by the same machine, variable speed control is essential. For example, the REEVES Variable Speed Transmission, with which this "National" Hose Wrapper and Roller is equipped, enables the operator to adjust speeds quickly and accurately to accommodate any size hose, tubing, etc., from $\frac{5}{8}$" to 15" in diameter. Speeds ranging from 25 to 200 feet per minute are available.



ON WEIGHING CONVEYORS

Proportioning by weight of constantly fed materials to produce uniformly mixed products, such as cements, foods, chemicals, compounds, etc., requires extremely accurate and positive speed control. To accomplish these results, on the weighing conveyor shown above, the Merrick Scale Mfg. Co. has adopted the REEVES Vari-Speed Motodrive as standard equipment on this and many other Feedoweight units.



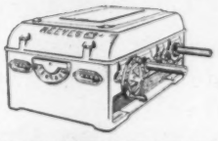
ON PRINTING PRESS

Many new and important features are incorporated in this American Type Founders Kelly Clipper Printing Press—including accurate and positive variable speed control secured through a REEVES Vari-Speed Motor Pulley, with which the press is standardly equipped. Size of form, weight of paper, amount of ink coverage, all dictate the proper speed at which the press should be operated, and this speed is secured simply by turning the REEVES handwheel.

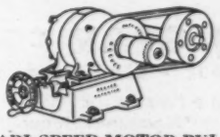
• You, too, can use REEVES Speed Control profitably on *your* machines. Send for latest Catalog G-397, which illustrates and describes the REEVES line of Speed Control equipment and its use as standard equipment on 1,327 different machines.

Reeves Pulley Co., *Dept. H,* **Columbus, Ind.**

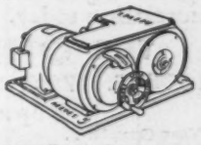
THE 3 BASIC UNITS IN THE *Reeves* LINE



VARIABLE SPEED TRANSMISSION for infinite speed control over wide range—2:1 to 16:1 inclusive—and for heavy duty service. Fractional to 78 h.p. capacities.



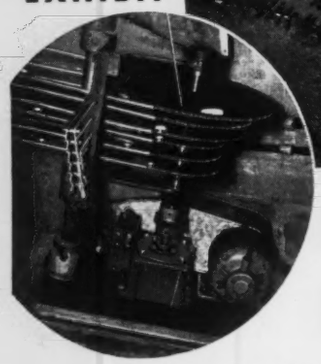
VARI-SPEED MOTOR PULLEY for direct application to shaft extension of any standard motor and for ratios of speed variation not exceeding 3:1 range.



MOTODRIVE which combines motor, variable speed drive and gear reducer in a single compact unit. Fractional to 10 h.p. capacities; speed range 2:1 through 6:1.

Reeves ACCURATE • POSITIVE SPEED CONTROL

in the **GENERAL MOTORS EXHIBIT**



OHIO GEAR REDUCERS Speed "Traffic"

• Thousands of tiny cars, speeding along super highways in the New York World's Fair exhibit, Highways and Horizons, present General Motors' prophetic picture of our traffic of the future.

Behind the scenes lies a marvel of integrated power transmission. More than 13,000 feet of chain animate the 16,000 cars. The longest single installation consists of seven chains, each 370 feet in length. Three different sizes of sprockets speed the cars at 50, 75, and 100 miles per hour. At the heart of the unit, translating the power of the electric motor into the action of the cars, is an Ohio Gear Reducer. Similar Ohio Reducers animate other portions of the FUTURAMA.

Three factors governed the selection of the Ohio Gear Reducer: (1) it is mechanically perfect; (2) it is reasonably priced; (3) it is readily available.

Won't those same factors provide more efficient, more economical answers to your power transmission problems? See what Ohio Gear engineering and service can do for you. Get full information today.

THE OHIO GEAR CO.

1338 E. 179th Street • Cleveland, Ohio

Representatives

*New York City, N. Y.
Patron Transmission Co.
154-156 Grand Street
New England George G. Pragst
260 Esten Ave., Pawtucket, R. I.
*Los Angeles, Calif.
J. W. Minder Chain & Gear Co.
927 Santa Fe Avenue
Grand Rapids, Mich.
W. H. Slaughter
419 Oakdale St., S. E.
*Pittsburgh, Pa.
Standard Machinists Supply Co.
South 2nd and McKean Street
Detroit, Mich.
George P. Coulter
322 Curtiss Building
*Minneapolis, Minn.
Industrial Supply Co.
537 S. Seventh St.
Buffalo, N. Y.
F. E. Allen, 2655 Main St.
*Kansas City, Mo.
Kansas City Rubber & Belting Co.
712 Delaware Street
*San Francisco, Calif.
Adam-Hill Co.
244-246 Ninth St.
Louisville, Ky.
Alfred Halliday, 330 Starks Bldg.
*Indianapolis, Ind.
A. R. Young
518 North Delaware Street
St. Louis, Mo.
St. Louis Tool Co.
2319 N. Ninth Street

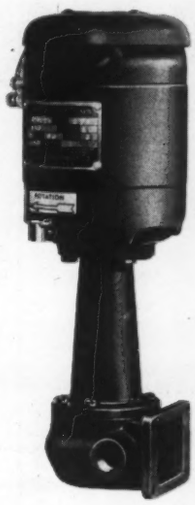
Stocks carried.

OHIO GEARS

speeds with a resulting fine surface finish and without reduction in tool life, it is claimed. The bessemer steel, Union Maxcut, has physical properties comparable to SAE X-1112. Parts made of it show a smooth fine finish when machined at 280 surface feet per minute with a basic feed of .0095-inch and an average tool life of more than 11 hours. Union Multicut, new open hearth steel, has physical properties similar to those of SAE 1115, parts showing a fine finish comparable to that of bessemer screw stock when machined at 275 surface feet per minute with a basic feed of .0087-inch and an average tool life better than eight hours.

Coolant Pumps for Moderate Duty

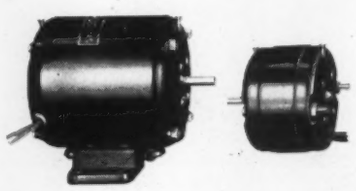
ADDITION of a line of smaller coolant pumps, Model P-3, is announced by the Ruthman Machinery Co., 540 East Front street, Cincinnati. These pumps are especially adapted to small machine tools and to larger machines requiring only a moderate volume of coolant. Like larger Gusher coolant pumps, essential features include a built-in motor, sturdy vertical shaft suspended on precision ball bearings, double suction intake providing a balanced impeller. There is no metal to metal contact in the impeller. Four standard types are listed.



Especially adapted to small machine tools, smaller coolant pumps may also be used on larger machines requiring moderate coolant volume

Fan Duty Motors Operate Vertically

AVAILABLE in two frame sizes with capacities ranging from approximately 1/400 to 1/25-horsepower, a line of shaded pole motors, in pressed steel frames, is announced by the Emerson Electric Mfg. Co., St. Louis. The small frame is furnished with detachable strap base and the large frame can be furnished with rigid saddle base or resilient hub mounting. All ratings can be furnished without base, with extended through-bolts for stud mounting. Motor design includes a covered bearing in the back cover which has a fiber thrust plug to absorb the thrust action of the



Design of shaded pole motors includes covered bearing in back cover which has fiber thrust plug to absorb shaft thrust

THE DIRECTORY OF MATERIALS TELLS....

WHAT, WHY—AND WHERE TO GET IT

MACHINE DESIGN's Eighth Annual Directory of Materials will accompany the October issue as another removable, filable supplement. As in the past it will be the simplest and most complete source-book of information on materials available to Design Executives, Chief Engineers and Designers of machinery. Its contents are compiled to answer the all-important questions of tradenames, principal properties and sources of supply. *It is the handbook of preliminary materials information.*

The 1940-41 Directory will contain an entirely new listing of materials—machine finishes—in addition to the seven lists of different materials previously included . . . all completely revised and brought up-to-date. In the coming Directory of Materials, users will find extensive information on:

1—Alloys, Ferrous and Nonferrous, by Tradenames.
2—Plastics and Nonmetallic Materials, by Tradenames.
3—Producers of Tradenamed Materials.
4—Stampings Producers.
5—Forgings Producers.
6—Die Castings Manufacturers.
7—Plastics Molders.
8—Producers of Machine Finishes.

Additional copies of the Directory will be available for twenty-five cents. To insure sufficient copies for members of your staff, we suggest placing your order in advance of publication.

Manufacturers and processors of Alloys, Plastics, Machine Finishes and other Engineering Materials may augment their necessarily condensed listings in the Directory with display space, in which application photographs and detailed descriptive matter concerning their products can be shown. Regular advertising rates prevail . . . final closing date September 11. For further information write MACHINE DESIGN, Penton Building, 1213 West Third Street, Cleveland, Ohio.

MACHINE DESIGN

PARTS · MATERIALS · METHODS · FINISHES

Micro-Weave
All American
TRACING CLOTH

We are not using that expression All American in any "flag waving" sense. We mean that all material, all labor, all control of quality is free from the influences of conditions abroad. We mean that you have a dependable source of supply right here in the U. S. A. insuring prompt deliveries, price stability and product dependability.

Write for sample testing sheets of Micro-Weave Tracing Cloth — try it yourself.

The Holliston Mills, Inc., Norwood, Mass.
Companion Products:
Royal Blue Print Cloth and Photo Cloth.
BOSTON · NEW YORK · PHILADELPHIA · CHICAGO
ST. LOUIS · RICHMOND

Micro-Weave
MORE THAN 180 FLAWLESS THREADS PER SQ. INCH

The dispensing roll container is a protection, a convenience and an identification. It keeps the cloth clean — handy brackets attach to desk or table.

shaft. These motors are suitable for vertical operation, shaft end up. Applications include those that do not impose a heavy starting load and that come up to full speed quickly.

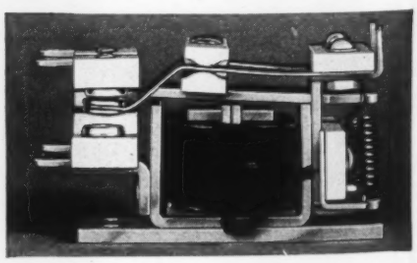
Smaller Oil Conditioner Added

ADDITION of a smaller popular size Kralinator oil conditioner to its line is announced by Olixir Products Co., 887 Niagara street, Buffalo, N. Y. A replaceable, impregnated conditioning element is used for separation of foreign matter from the lubricating oil. This element has surprisingly long life and may be replaced easily without long or expensive shut-downs.

Replaceable, impregnated conditioning element is used for separation of foreign matter in oil conditioner

Relay Maintains Adjustment

RELAY No. 25, 1.5 watts input and 2000 watts output, is announced by Kurman Electric Co. Inc., 241 Lafayette street, New York. A life test of this relay showed that adjustments were maintained for over seven million operations and that the heat rise was less than 25 degrees Fahr. above the ambient temperature. Contacts are pure silver and will carry 10 amperes on 110-volt, 60-cycle current. Magnet frame is heat treated, nonaging silicon steel, heavily cadmium plated. By proper cross connection, this relay may be used as single pole, single or double throw, multiple or series break. Extra make contacts can be provided.

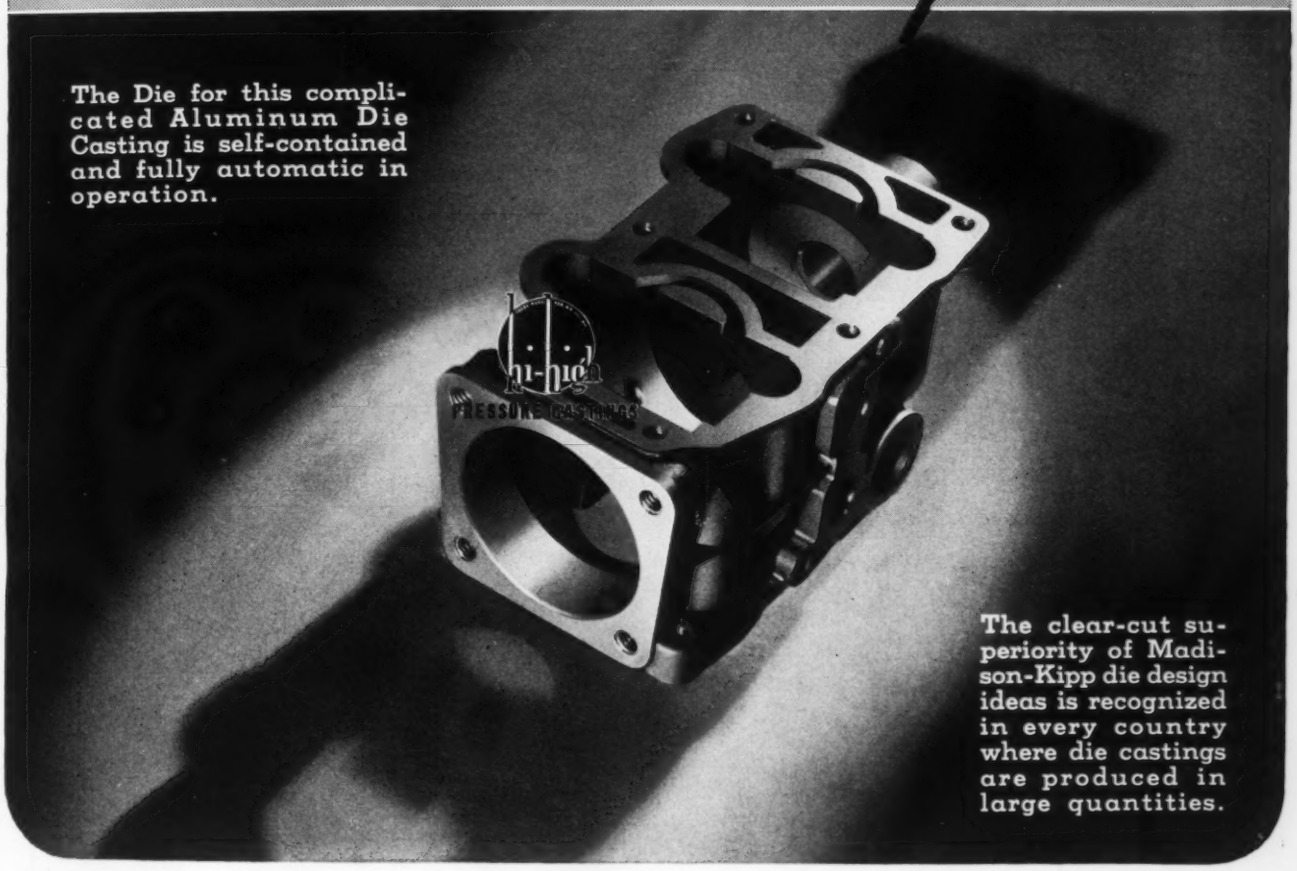


By proper cross connection, relay may be used as single pole, single or double throw, multiple or series break

Finishes Intended for Infra-Red Baking

INTENDED especially for use with infra-red baking equipment, a new line of finishes is announced by Ault & Wiborg Corp., 75 Varick street, New York. Formulations developed include both undercoats and topcoats

Madison-Kipp
AL.-MG.-ZN.-BR.
Die Castings



The Die for this complicated Aluminum Die Casting is self-contained and fully automatic in operation.

The clear-cut superiority of Madison-Kipp die design ideas is recognized in every country where die castings are produced in large quantities.

Madison-Kipp has patented the greatest machine in its history for casting the higher temperature die casting metals to exact analyses at pressures up to 25,000 pounds per square inch or over if casting factors make such pressures necessary or desirable.

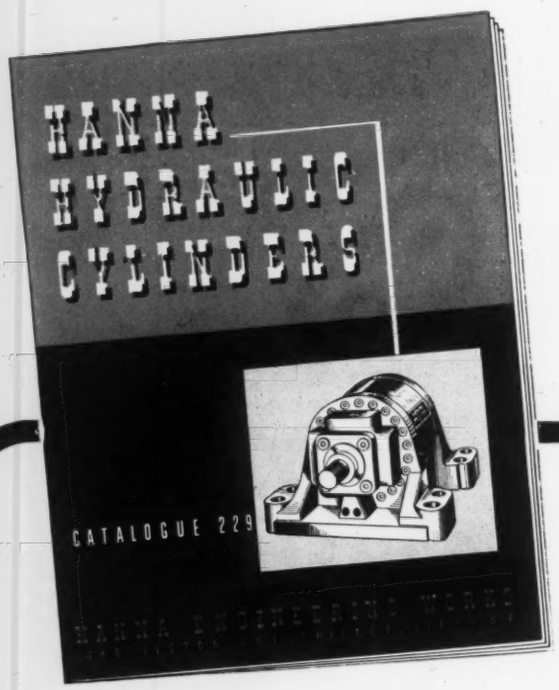
This Madison-Kipp hi-high pressure process under which the dense, strong, inexpensive Aluminum casting above illustrated was made may be your opportunity to increase the quality and the appearance and the utility of your product at an overall cost saving.

Madison-Kipp die casts all die casting alloys of Aluminum, Magnesium, Zinc and Brass. All price estimates are made at Madison, Wisconsin.

Complete:
DIE CASTING SERVICE
FRESH OIL LUBRICATORS
HIGH SPEED AIR TOOLS

Sole Agent in England: Wm. Coulthard & Co., Ltd., Carlisle

MADISON-KIPP CORPORATION, 210 Waubesa St., Madison, Wis., U. S. A.



YOU SHOULD HAVE THIS

Hanna HYDRAULIC CYLINDER Catalogue

THIS very complete catalogue will help your engineering department and shop select the proper cylinder for every application. It contains illustrations, dimensions, capacities, and engineering data covering the broad line of standard Hanna Hydraulic Cylinders. Included also are details of Hanna Air Cylinders and valves.

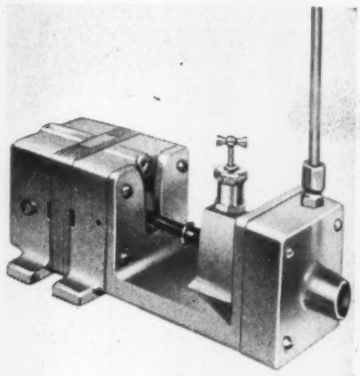
Send today for this Catalogue, No. 229—of course its free to executives and engineers.

Hanna Engineering Works
1772 ELSTON AVENUE
CHICAGO, ILL.

in a full range of plain colors without limitations as to luster. Hammered effect and wrinkle finishes are also available. Infra-red baking, it is claimed, speeds up baking time, lowers capital investment in ovens, has increased flexibility in use and saves floor space.

Small Rotary Pumps for Displays

SMALL rotary pumps—sump style type O1 for light bodied transformer oil, and gland style type O2 for use on displays where only water can be used—are announced by Speedway Mfg. Co., 1834 South Fifty-second avenue, Cicero, Ill. Built integrally with the motor, type O1 is best used when located in a sump well of oil

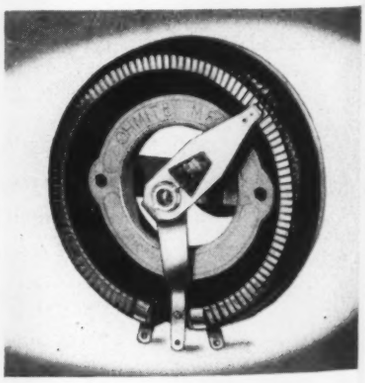


Sump and gland style rotary pumps are for light bodied transformer oil and water, respectively

and calls for no attention to either cooling, oiling or leakage from glands. Type O2 has a flexible self-aligning coupling between the motor and pump proper, and all parts are rust-proof. Housing is aluminum alloy, impeller blade and shaft are stainless steel. It has two-way grease distribution to the adjustable cone-type packing gland chamber.

Rheostat Has Close Control

MODEL T, a 750-watt vitreous enameled rheostat, is announced by the Ohmite Mfg. Co., 4835 Flournoy street, Chicago, filling in between the 500 and 1000-watt models. Like other Ohmite rheostats, Model T. provides permanently smooth, close control, and dissi-



Rheostat is available in straight or tapered winding, in single or tandem assemblies or rheostat cages

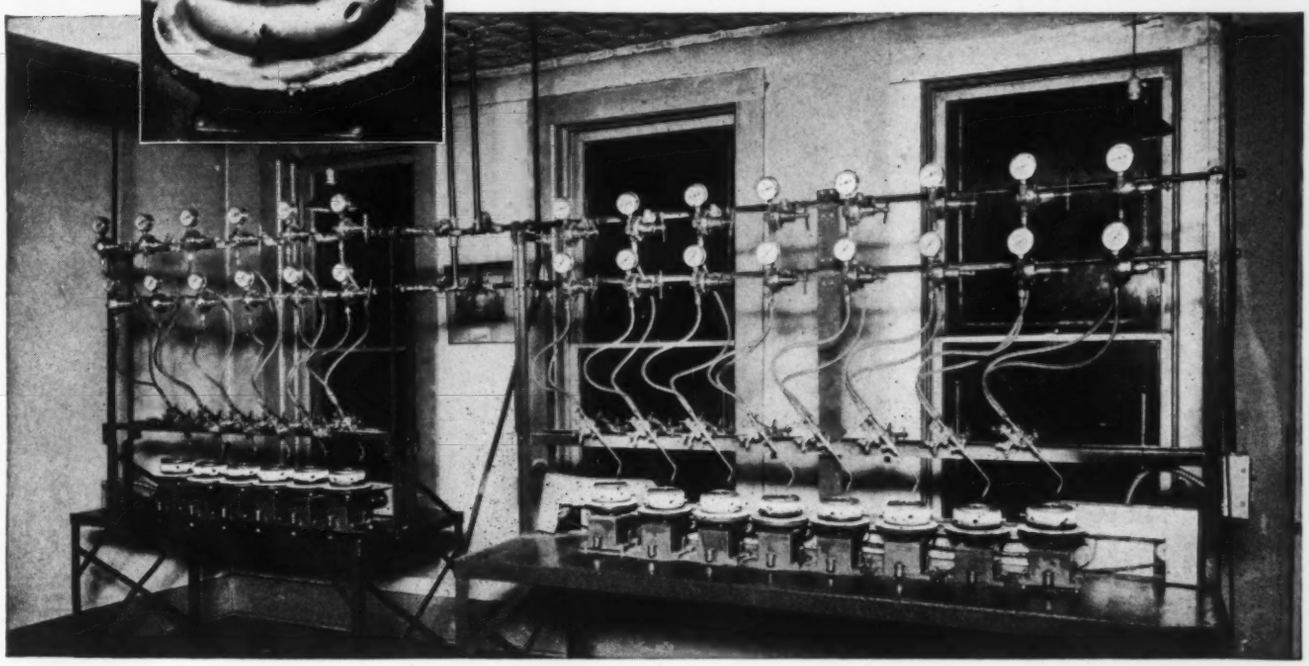
pates heat rapidly. Available in straight or tapered winding, this rheostat is available in single or tandem assemblies or rheostat cages.

Add to Plastic Compound Series

AN ADDITION to the 1900 Black series of phenolic molding compounds, to be known as Durez 1905 Black, is announced by Durez Plastics & Chemicals Inc., North Tonawanda, N. Y. This material has an impact strength of .6 (ASTM) and heat resistance up to 418

AIRCO

WELDED DESIGN *Simplifies* OIL FLOAT ASSEMBLY



Skimming the "cream" from the crankcase oil to assure clean, viscous oil is the job being done by the Taylor Float-O-Oil suction intake. Speed plus permanent tightness are two "musts" in the assembly of this oil float.

Oxyacetylene welding proved to be the best method of attaining these essentials. Using the economical Airco production welding process, the thin pressed steel body and cover of the oil float are welded together with a "standing seam." Then, a brass pipe gooseneck is joined to the steel body at the side and to the cover plate. The result — a light, permanently tight, speedily assembled float which rides on the oil's surface, rising and falling as the oil level changes.

This is another example of how Airco customers are continually benefiting by using economical Airco Oxygen, guaranteed to be 99.5% pure (it exceeds U.S.P. requirements), Airco Acetylene, Airco Welding Apparatus and the assistance of Airco's Applied Engineering Department. Airco engineers will be glad to send our experienced adviser to help you solve any problem involving the use of the oxyacetylene process. Write for full details.

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AIRCO *Anything and Everything for* GAS WELDING or CUTTING and ARC WELDING WILSON

1391 lb. Punch Press bases made of Meehanite by American Brake Shoe and Foundry Company.

These Punch Press Bases COST NO MORE and PERFORM BETTER

The vibration damping (shock absorbing) property of Meehanite combined with its compressive strength of 165,000 lbs. per square inch and tensile strengths up to 60,000 lbs./sq. in. have created new standards of engineering design and economy in punch press manufacture.

Absco Meehanite castings are supplied rough or finished in quantity lots for production parts or singly to individual design. Meehanite is particularly suited to machine tool construction requirements.

Write for full particulars to Department D

SELECTIVE PROCESSING provides ABSCO Meehanite with the combination of these qualities that fits your needs.

1. ***Combined strength and toughness***
2. ***Acid and corrosion resistance***
3. ***Abrasion and erosion resistance***
4. ***Pressure tightness***
5. ***Ability to stand shock and strain***
6. ***Intense hardness through chilling or heat treatment***

THE AMERICAN BRAKE SHOE AND FOUNDRY COMPANY

BRAKE SHOE AND CASTINGS DIVISION

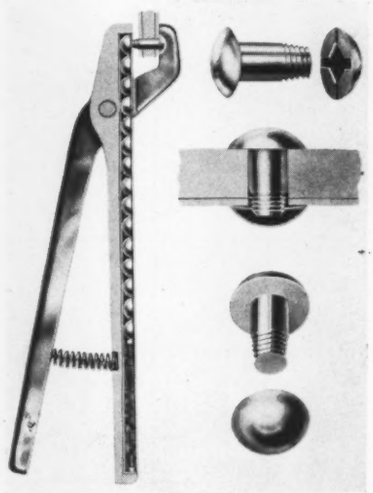
FOUNDRY
MAHWAH
NEW JERSEY

OFFICES
30 Park Avenue, New York, N.Y.
332 South Michigan Ave., Chicago, Ill.

degrees Fahr. Unusually good gloss for high impact compounds is claimed. It is available only in the new particle size especially suited for free flowing through feeders and hoppers to simplify the production of preforms. Because of the high bulk factor of the series, deeper preform cavities are required.

Screw Assembly Made Available

CONSISTING of a fastener and a spring locking button, a new fastening assembly is announced by Hopkan Rivet Co., 128 Latham street, Pittsburgh. The fastener stud has a head and a shank, the latter being tapered toward the end and provided with a plurality of parallel grooves. Provided with an inwardly extended spring in locking lugs, the locking button cooperates with the tapered grooved end of the shank to give locking action. The fastener can be made of any type of alloy and the spring locking button is available in any size or shape.



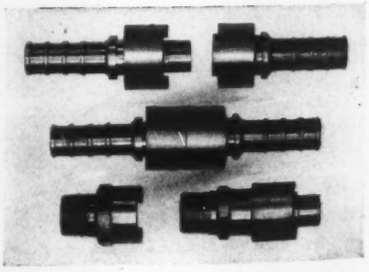
Locking button provided with spring co-operates with tapered grooved end of fastener shank to give locking action

Relay, Transformer for Low-Voltage

A NEW magnetic relay with control transformer, for heating and air conditioning control, is announced by General Electric Co., Schenectady. The units are used as the relaying means between low-voltage thermostats, limit switches, or other low-voltage controls and line-voltage loads such as motors.

Hose Couplings Have Positive Lock

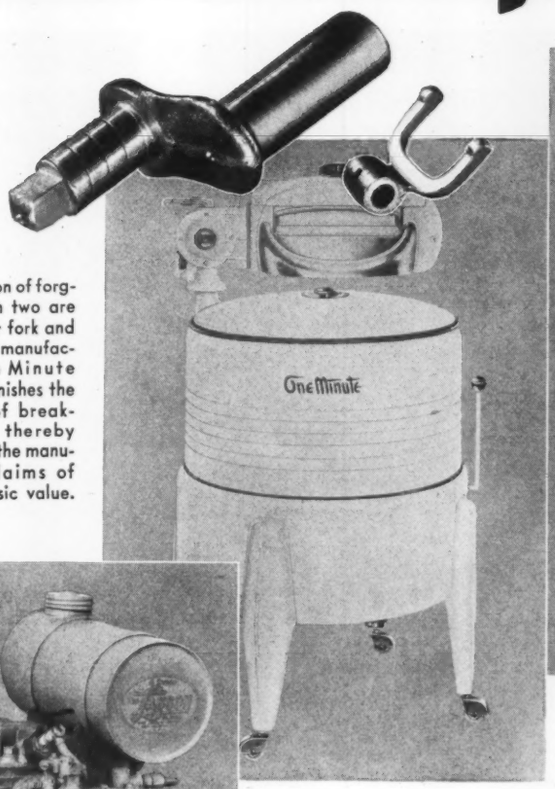
A NEW line of cast bronze hose couplings for joining similar or dissimilar sizes of rubber hose on air, water, steam and gas lines operating up to 200 pounds pressure per square inch, has been developed by the Pittsburgh Brass Mfg. Co., 3227 Penn avenue, Pittsburgh. Trade named Fuline, these couplings employ a positive locking device. Standard sizes are available



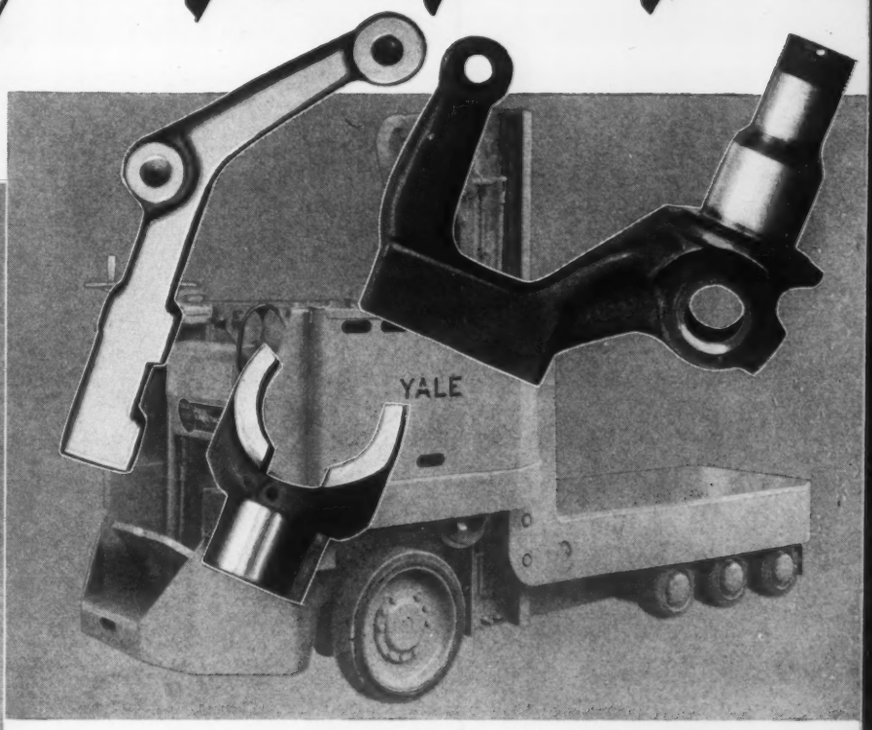
Similar or dissimilar sizes of rubber hose on air, water, steam and gas lines may be joined by new couplings

A WIDE RANGE OF COMBINATIONS OF ESSENTIAL "QUALITY ADVANTAGES"

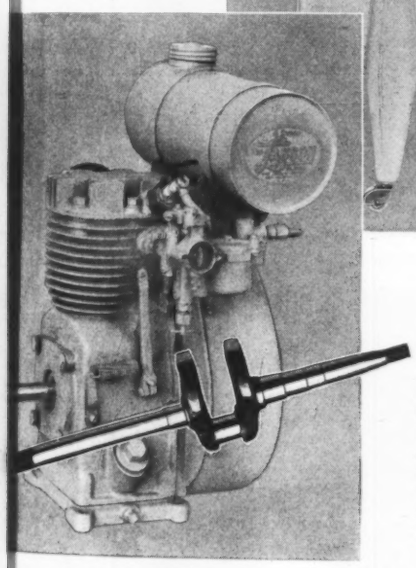
IS OBTAINABLE IN *Forgings*



The application of forgings, of which two are shown (shifter fork and crank), in the manufacture of One Minute Washers diminishes the possibility of breakdowns, and thereby substantiates the manufacturer's claims of greater intrinsic value.



This Yale and Towne Electric Elevating Platform Truck is designed for heavy duty service, and some 70 forgings are used in its construction.



Lauson ½ Horse Power, 4-Cycle Vertical Engine, weighing only 25 pounds, embodies a balanced forged crankshaft, and is said to be the lightest, most compact, 4-cycle engine in the world.

FORGINGS are used for the purpose of obtaining specific "quality advantages" which are not otherwise available. Whether it's maximum tensile and torsional strength combined with reduction of deadweight, and welding adaptability, and low machining costs, or plus strength combined with uniformity of physical properties for interchangeable parts and low machining costs, or any one of several other combinations of "quality advantages," you'll get exactly what you require by using forgings.

Maximum tensile and torsional strength in forgings is obtainable through controlled grain flow and distribution of metal rather than by metal bulk. Forging kneads metal into a dense mass of flawless strength—strength that is achieved through a concentration of grain structure and fiber formation at points of greatest shock or strain, thereby providing high fatigue resistance and underwriting dependable performance over longer periods of use. Forgings are formed to close tolerances in dies that assure uniform size and shape, thereby reducing machining costs because there is no bulk of excess metal to remove, while unusual freedom from concealed defects avoids loss from rejections. Consult a competent forging engineer about the wide range of combinations of "quality advantages" that are available in forgings.

7 "QUALITY ADVANTAGES" OF FORGINGS:

1. **Strength:** maximum tensile and torsional strength.
2. **Uniformity of Physical Properties:** obtainable in forgings in the exact degree desired.
3. **Weight Reduction:** through maximum strength and lighter sectional thicknesses.
4. **Welding Adaptability:** widest range for fabricating complicated parts from two or more forgings.
5. **Lower Machining Costs:** forgings shaped in closed dies require a minimum of machining and finishing.
6. **Safety:** through freedom from concealed defects.
7. **Endurance:** forgings provide high fatigue resistance which insures dependable performance over longer periods of use.

"Drop Forging Topics" presents actual applications of forgings in a wide variety of types of equipment and tells the advantages and economies derived from the use of forgings by various manufacturers. "Drop Forging Topics" is sent free to engineers, designers, metallurgists, production and management executives. If you are not receiving it, send us your name today. It's free.

THERE ARE NO SUBSTITUTES FOR FORGINGS

DROP FORGING ASSOCIATION
605 HANNA BUILDING · CLEVELAND, OHIO

SYMBOLIC EMBLEM OF THE DROP FORGING ASSOCIATION

NOPAK CONTROL VALVES

for Air and Hydraulic Service

NOPAK 3- and 4-Way foot operated Air Control Valves are available with 3 types of pedal equipment.

NOPAK 3- and 4-Way Solenoid operated Air Control Valve.

•

For Complete Information on NOPAK Valves, write for Bulletin 65

NOPAK Cushioned Air Cylinder, Trunnion Mounting.

...are practically wearproof and leak-proof...engineered and built to improve with use . . . provide positive control of air or hydraulic power on your machines.

The NOPAK Flat-Disc principle (the basic patented feature in all types of NOPAK Valves for Air, Gas, Oil or Water) results in extremely simplified design, rugged construction, the absence of wearing parts.

Such NOPAK features as Pressure Sealing, Self-Aligning Packless Valve-Stem, Full Pipe Area thru Valve, Quick or Throttling Action . . . provide your machines with added assurance of Life-Time Valve Efficiency . . . Life-Time Protection against valve failure.

NOPAK Air Cylinders

—available in 3 types, 6 standard mountings. The new Self-Regulating Type with Built-in Air Cushion is particularly adapted to machine movements where *constant cushion-effect* must be maintained. For particulars, write for Bulletin 77.

NOPAK VALVES and CYLINDERS

DESIGNED for AIR or HYDRAULIC SERVICE

GALLAND-HENNING MFG. CO.

Representatives in Principal Cities

2752 SOUTH 31st STREET • MILWAUKEE, WISCONSIN

A 3074-½

for ⅜, ½ and ¾-inch hose. Larger sizes can be built to specifications.

Hydraulic Valves Utilize Stainless Balls

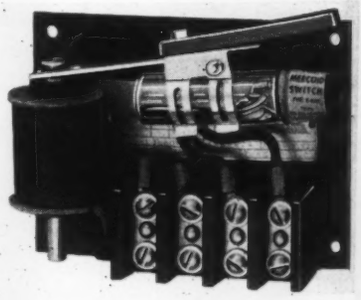
FOR use in hydraulic presses and machinery, a new series of valves is being marketed under the name Hydra by the Albright Equipment Co., 922 Crafts building, Pittsburgh. They may be used on water, steam and oil lines, having pressures up to 4000 pounds per square inch. Only one-eighth turn of the operating handle is required to open and close the valve. During this operation, the four stainless steel balls that close the valve are automatically engaged into port holes

Series of valves may be used on water, steam and oil lines in hydraulic presses and other machines

because of pressure on the line. Laboratory tests, it is said, showed no signs of wear or leakage after 300,000 opening and closing operations with a hydraulic pressure test of 450 pounds to 4000 pounds per square inch. These valves are made in three body types—brass, bronze and steel—and standard sizes are ½, ¾, 1, 1¼, 1½ and 2-inch diameters.

Mercury Relay Actuated by Solenoid

A PLUNGER type solenoid actuates a tilting arm to which a mercury switch is attached in the type W-6 relay announced by the Mercoid Corp., 4203 Belmont avenue, Chicago. When the coil is energized the plunger floats within the plunger guide tube, reducing to a minimum the noise of alternating current vibrations. The contact cannot be held closed by residual



Only very low current is required to energize solenoid in mercury relay, so that it may be employed for remote control

magnetism. Since only a very low current is required to energize the solenoid, this relay may be employed for remote control.

Pushbuttons Protected by Guard Rings

ONE and two-button standard duty pushbutton stations in a new line are announced by General Electric Co., Schenectady. Protected from accidental operation by guard rings, these stations have enclosures made entirely of steel. Contacts of fine silver

PREPAREDNESS FOR NATIONAL DEFENSE

★

FOR the swift mobilization of America's mass production resources, in the service of national defense, Bower was fully prepared.

Always geared up for high capacity production, Bower's facilities were immediately available to manufacturers of defense equipment.

And the Bower product, already approved in every leading industrial field, could be used at once for implements of defense.

All manufacturers of bearing-equipped machinery are invited to submit their bearing requirements to Bower engineers.

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ROLLER BEARING CO.
Detroit, Michigan

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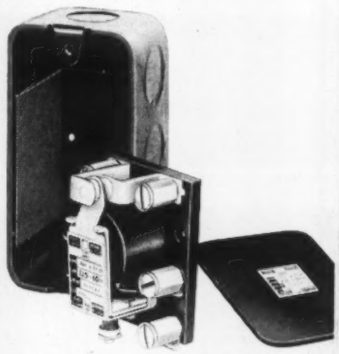
backed by steel are arranged to provide a double-break action and are spot welded to the supporting cross-bar. As the contacts close, a rolling action produced by an off-center contact bar causes the contacts to roll slightly, assuring a good contact and tending to prevent welding. Terminals are spun onto the molded base in such a position that the base provides both an attachment and a firm support for the terminal. Hence considerable pressure can be put on the terminal screw without bending the terminal out of place or pulling it from the base on which it is mounted.

Relay Handles One Horsepower

DESIGNED for use on either alternating or direct current, a new midget relay is announced by Ward Leonard Electric Co., Mount Vernon, N. Y. It is available with contacts arranged for single-pole, normally open, normally closed or double throw. The relay is rated to handle approximately one-horsepower

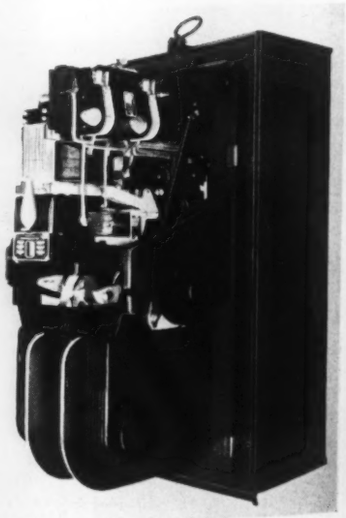


Midget relay is designed for use on either alternating or direct current, with any of several contact arrangements

and is furnished with coils for operation on standard voltages up to 110/115 volts at standard frequencies. On 220/230 volts, coils can be supplied for not less than 50 cycles.

Circuit Breaker Has New Contacts

TYPE K. B. three-pole, 600-ampere circuit breaker is announced by I-T-E Circuit Breaker Co., Philadelphia. It is mounted in an individual steel enclosure of the pull-box type. A new contact structure is utilized,



Silver-nickel contact blocks, brazed to heavy copper bars, are utilized in three-pole circuit breaker

employing silver-nickel blocks, Gibsiloy Grade A-3, electrically brazed to heavy copper bars. This alloy was

Acme Steel Co.
Ajax Flexible Coupling Co.
Allis-Chalmers Mfg. Co.
American Can Co.
American Chain & Cable Co.
American Gas Furnace Co.
American Laundry Mach. Co.
American Locomotive Co.
Anaconda Copper Mining Co.
Anchor Post & Fence Co.
Appleton Electric Co.
Armstrong Machine Works
Atlas Lumnite Cement Co.
Atlas Powder Co.
Bakelite Corp.
Baldwin Belting & Leather Co.
Baldwin-Duckworth Div.
Baldwin-Southwark Corp.
W. F. & John Barnes Co.
Bethlehem Steel Co.
Black & Decker Mfg. Co.
Blaw-Knox Co.
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Carboloy Co., Inc.
Carrier Corp.
Carter Carburetor Co.
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Century Electric Co.
A. B. Chance Co.
Chicago Bridge & Iron Co.
Chicago Molded Products Co.
Cincinnati Bickford Tool Co.
Cincinnati Milling Machine Co.
Cincinnati Shaper Co.
Clark Controller Co.
Cling Surface Co.
Colgate-Palmolive-Peet Co.
A. M. Collins Mfg. Co.
Columbia Alkali Corp.
Combustion Engineering Co.
Continental-Diamond Fibre Co.
Copperweld Steel Co.
Cornell-Dubilier Elec. Corp.
Crown Cork & Seal Co.
Cuno Engineering Corp.
Cutler-Hammer Inc.
Detroit Rex Products Co.
Diehl Mfg. Co.
Ditzler Color Co.
Dodge Mfg. Corp.
Dole Valve Co.
Domestic Engineering Co.
Duff-Norton Mfg. Co.
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Fairbanks Morse & Co.
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Graver Tank & Mfg. Co.
Graybar Electric Co.
A. P. Green Fire Brick Co.
Guardian Electric Mfg. Co.
Hamilton Mfg. Co.
Hays Corp.
Heald Machine Co.
Hinde & Dauch Paper Co.
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Koehring Co.
Lamson & Sessions Co.
Landis Tool Co.
R. K. LeBlond Machine Tool Co.
R. G. LeTourneau, Inc.
Lignum-Vitae Products Corp.
Lindberg Engineering Co.
Link-Belt Co.
Locke Insulator Co.
Magnus Chemical Co.
Manhattan Rubber Mfg. Div.
Mason-Neilan Regulator Co.
Mattheson Alkali Works
Mattison Machine Works
Milcor Steel Co.
Mono Service Co.
Monsanto Chemical Co.
Morganite Brush Co.
Morse Chain Co.
National Automatic Tool Co.
National Carbon Co., Inc.
National Process Co.
Nation Vulcanized Fibre Co.
Neptune Meter Co.
New England Coke Co.
New Jersey Zinc Co.
N. Y. Belting & Packing Co.
Nicholson File Co.
Northern Electric Co., Ltd.
Norton Co.
Novo Engine Co.
Ohio Brass Co.
Owens-Corning Fiberglas Corp.
Owens-Illinois Glass Co.
Pangborn Corp.
Pennsylvania Salt Mfg. Co.
Permutit Co.
Philadelphia Quartz Co.
Pittsburgh Equitable Meter Co.
Pittsburgh Reflector Co.
Pneumatic Scale Corp., Ltd.
Read Machinery Co., Inc.
Reeves Pulley Co.
Reliance Elec. & Eng.
Republic Bank Note Co.
Republic Flow Meters Co.
Republic Steel Corp.
Resmans Prod. & Chem. Co.
R. W. Rhoades Metaline Co., Inc.
Robins Conveying Belt Co.
Rockbestos Products Corp.
John A. Roebling's Sons Co.
Rotor Tool Co.
Joseph T. Ryerson & Son, Inc.
S K F Industries, Inc.
Sangamo Electric Co.
Scott Paper Co.
Shepard Mills Crane & Hoist
Simonds Saw & Steel Co.
Sloan Valve Co.
W. W. Sly Mfg. Co.
Stanley Works
Superheater Co.
Surface Combustion Corp.
Taylor Instrument Co.
Thermoid Co.
Thew Shovel Co.
Timken-Detroit Axle Co.
Timken Roller Bearing Co.
Truscon Steel Co.
Union Carbide Co.
Union Steel Products Co.
Unitcast Corp.
U. S. Pipe & Foundry Co.
U. S. Rubber Co.
U. S. Steel Corp.
Edward Valve & Mfg. Co.
Vickers, Inc.
Edward W. Voss Machinery Co.
Wagner Electric Corp.
Walton Truck Co.
Warner & Swasey Co.
Waukesha Motor Co.
West Disinfecting Co.
West. Elec. Instrument Corp.
West Penn Power Co.
Western Precipitation Corp.
Westinghouse Elec. & Mfg. Co.
Weyerhaeuser Sales Co.
Wheeler Reflector Co.
Wickwire Spencer Steel Co.
Edwin L. Wiegand Co.
Wilson Mechanical Instr. Co.
Wiremold Co.
Wolverine Tube Co.
York Ice Machinery Corp.
International Nickel Co.
Irvington Varnish & Res. Co.
Johnston & Johnston, Inc.
Okonite Co.
Osburn Mfg. Co.
Otis Elevator Co.

Who finds it pays?

These are some of the 845 companies that sent representatives to the national N. I. A. A. Conference last year . . . to take part in group discussions of marketing problems . . . present case studies . . . and study the advertising methods of industrial leaders.

You are invited to the 18th annual Conference of industrial sales promotion and advertising executives in Detroit next September . . . to get new ideas and information that will make your 1941 program more effective, more profitable. Write now for details.

18th Annual **CONFERENCE** *and Exposition*
National **INDUSTRIAL ADVERTISERS** *Association*
SEPT. 18, 19, 20 . . . **DETROIT** . . . HOTEL STATLER

OZALID WHITEPRINTS are developed dry. There is no washing or fixing . . no waste of solutions or preparation of chemical baths. There is no drying of prints. Ozalid prints do not curl or wrinkle and are true-to-scale.

YOU MAKE FULL USE OF CUT SHEETS with dry-development . . . eliminate costly and wasteful trimming of prints . . . save as much as one-third in time, labor and materials.

AND THAT'S NOT ALL. Because of dry-development you can make duplicate tracings on Ozalid transparent paper, cloth or foil. You eliminate redrawing, cut drafting time, lower production costs.

Complete information on the Ozalid process and booklet of dry-developed Ozalid prints will be sent on request. Mail coupon today.

ONLY OZALID HAS DRY DEVELOPMENT

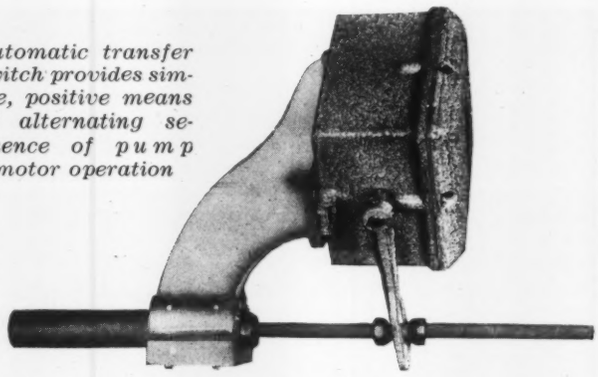
Ozalid
CORPORATION
ANSCO ROAD · JOHNSON CITY, NEW YORK

OZALID CORPORATION 52-8
Ansco Road, Johnson City, N. Y.
Please send me free sample booklet of dry-developed Whiteprints and complete information on the Ozalid Process.
*Name*_____
*Company*_____ *Title*_____
*Street*_____
*City*_____ *State*_____

chosen because of its low contact resistance and high conductivity over long periods.

Switch Alternates Motor Sequences

AUTOMATIC alternator for duplex pumping equipment is announced by the Barclay Control Co., 5182 Division street, Chicago. Known as the automatic transfer switch, this device provides a simple, positive means of alternating the sequence of pump motor operation. It will automatically cut in the idle pump under flood conditions. As illustrated, the outfit consists of a

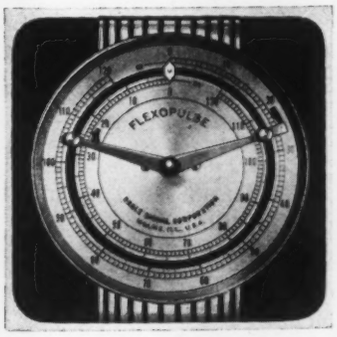


Automatic transfer switch provides simple, positive means of alternating sequence of pump motor operation

fully housed controller unit with slotted operating lever, constructed to take all sizes of float rods and cables. It operates equally well on alternating or direct current. Entire unit is mounted in a weatherproof, cast aluminum housing, and all internal parts are rust-proof.

Timer Provides Extreme Contact Range

UTILIZING reversing action without reversal of the motor, Flexopulse is a repeating cycle timer announced by Eagle Signal Corp., Moline, Ill., which provides an extreme range of contact in a continuously repeating series of operations. The cycle and percentage of contact closure time may be adjusted without changing gears or adjusting cams. Three models are available.

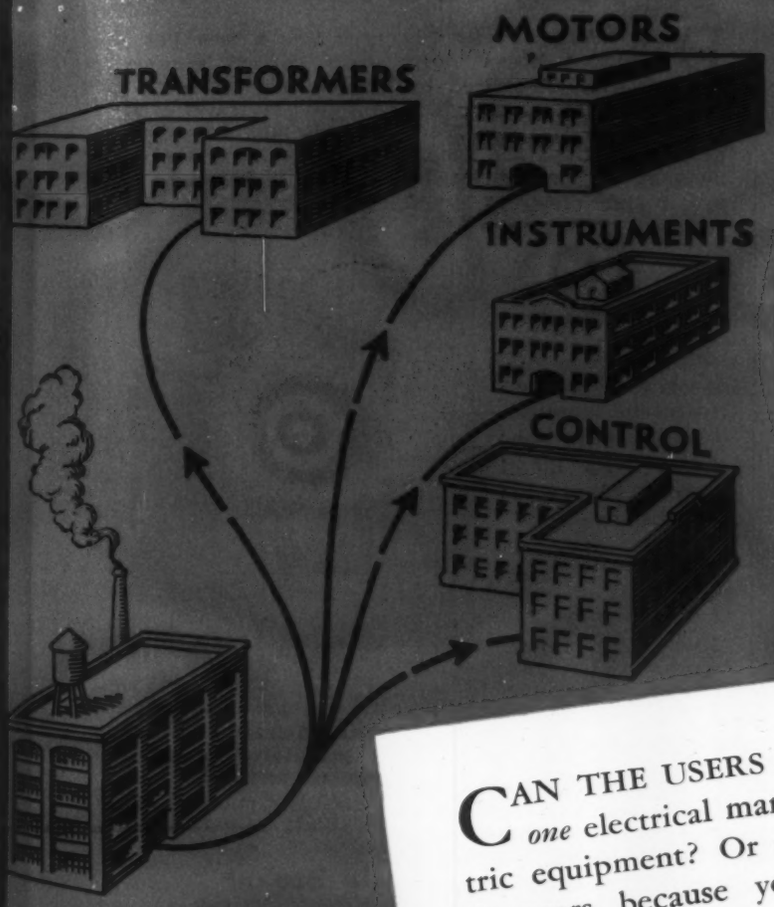


Cycle and percentage of contact closure time in repeating cycle timer may be adjusted without changing gears or adjusting cams

Swivel Couplings Added to Line

SWIVEL pipe couplings have been added to the line of rotating mechanical shaft seals made by the Syntron Co., 260 Lexington avenue, Homer City, Pa. These new couplings were designed primarily for the refrigeration industry to provide a positively sealed joint, capable of swiveling through a full 360 degrees, to carry refrigerator pipe line coils under either pressure or vacuum. They are also intended to provide free-swinging joints for highly flammable fuel such as

Where Must the Users of YOUR Machines Go for Service on Electric Equipment?



THIS USER IS WASTING TIME

His machine has electric equipment from several manufacturers. He must see them all for electrical repairs

THIS USER SAVES TIME

All the electric equipment on his machines was made by one manufacturer. He need go to only one service shop

CAN THE USERS OF YOUR MACHINES turn to *one* electrical manufacturer for service on the electric equipment? Or must they rely on *several* manufacturers because you use a patchwork of electric apparatus?

Turning to *several* manufacturers for service wastes the time and tries the temper of your customers. And you assume the burden of responsibility for the electric equipment, since you co-ordinated it.

DELEGATE THE RESPONSIBILITY

You can save yourself this trouble and please your customers by delegating *undivided responsibility* for the electric equipment to *one* manufacturer.

By choosing exclusively G-E equipment for your machines, you give your customers the benefit of G-E service. Wherever these customers are located, they'll find a G-E service shop close at hand. General Electric Company, Schenectady, N. Y.

011-234

G-E Undivided Responsibility Gives You

1. More time for other jobs you have to do.
2. The right motors and the right control.
3. Service shops for all equipment, convenient to all your customers.
4. Completely co-ordinated electric equipment for your machines.

GENERAL ELECTRIC

For Fewer Parts and More Compactness

Use This Small, Low-speed, G-E Synchronous Inductor Motor

RATINGS:
20 oz-in. at 75 rpm in 50L frame
40 oz-in. at 75 rpm in 50H frame
75 oz-in. at 75 rpm in 54H frame
2 oz-in. at 100 rpm in 20 frame
*48 oz-in. at 1 rpm in 20 frame
*24 oz-in. at 2 rpm in 20 frame
*12 oz-in. at 4 rpm in 20 frame
*Obtainable by means of built-in gear reduction

For use on: cam timers, clocks, demand meters, interval timers, phonographs, recording meters, signals, thermostats, time switches and other low-speed devices.

Imagine a small, synchronous, low-speed motor that, when used on certain devices, eliminates the number of parts previously required in the device, reduces the weight of the device, and increases its sales appeal. Then you'll have a good idea of the G-E synchronous motor for instruments or devices requiring a low-speed source of torque or power.

Here are some more advantages of this motor: It has extremely rapid acceleration and deceleration. The input to the motor is practically constant under all operating conditions. If you desire to reverse the motor, frequency of reversal has no appreciable effect on temperature rise. It will start all the load that it can handle when running. It is simple in construction—the rotor is the only moving part. It is quiet and efficient and does not interfere with radio reception.

To really appreciate this motor you must try it. Write TODAY if you think that you have an application for it. We'll be glad to send you more information. General Electric, Schenectady, N. Y.

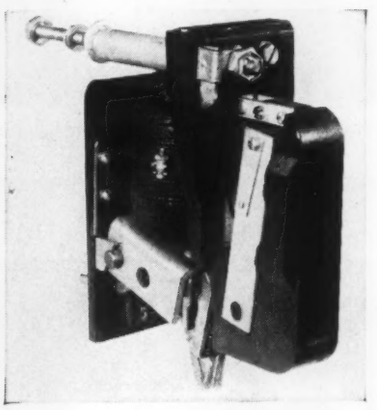
GENERAL ELECTRIC

700-4

gasoline. Two joints connected to each other by an elbow provide a full universal joint capable of withstanding high pressures and available in various pipe sizes.

Heavy Duty Contactors on Market

DESIGNATED series 200, type SM, a new line of improved heavy duty direct current magnetic contactors is announced by Westinghouse Electric & Mfg. Co., East Pittsburgh. Armature overtravel of the contactor is increased, contact tips are larger and nitrided bearings are used. Wearing depth of the contacts on all magnet-closed contactors is increased approximately one-third by extending the armature over-

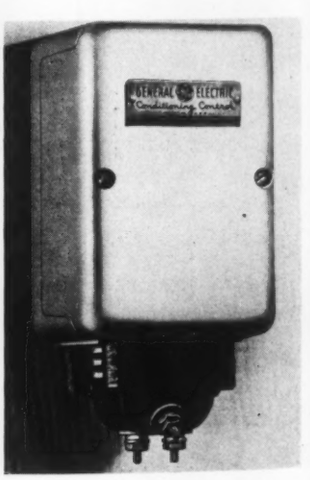


Armature overtravel of magnetic contactors in new heavy duty direct current line has been increased

travel. Heat is more efficiently conducted away from the contact surface by the enlarged mass of copper. The bearing pin holes of the armature bracket are reamed so that all play is reduced and centering is assured. The blowout coil is brazed to the contact support and heating is reduced.

Relay Controls Stoker

FOR controlling a stoker in conjunction with a time switch, limit controls and room thermostat, a new relay is announced by General Electric Co., Schenectady. It can also be used as a relay for blower motors of unit heaters controlled from a room thermostat; as



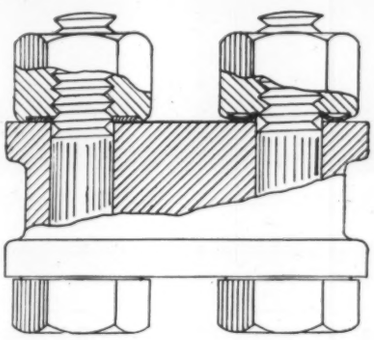
Relay for controlling a stoker in conjunction with a time switch may also be used as relay for blower motors

a relay between room thermostat and condensing unit in central cooling systems; and as a relay between humidistat and humidification systems. This single-pole relay combines in one compact assembly a relay,

low-voltage control transformer, and terminal board. Six terminals on a convenient terminal block provide means for line, load and limit control connections, without use of a connection box.

Locking Ring Expands in Nut

UTILIZING a locking principle that permits positive locking of the nut to the bolt, not to the work, a new one-piece, all-metal locknut is announced by An-cor-lox division of Laminated Shim Co. Inc., 64 Union street, Glenbrook, Conn. When the nut is applied on a bolt, the accurate-shaped metal locking

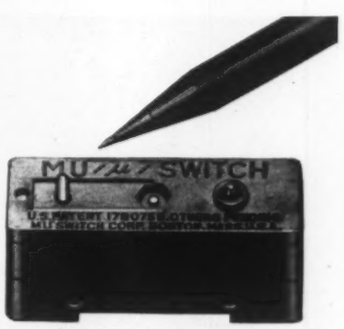


One-piece all-metal locknut utilizes locking principle permitting positive locking of nut to bolt

ring contained in the bottom of the nut is expanded by the locking pressure into the root of the bolt thread and against the nut rim. These nuts are available in all standard sizes and in all metals.

Manual Reset Device Protects Circuits

LOCKOUT protection for electrical circuits controlled by millibreak switches is afforded by the manual reset device now available with the normally closed, single-pole, precision switch made by Mu-Switch Corp., Canton, Mass. The manual reset comprises an insulated pin, projecting from the switch cover at the



Manual reset device of switch comprises an insulated pin, projecting from the switch cover at the end opposite the actuating button

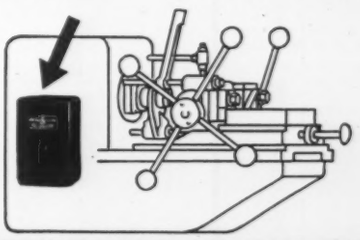
end opposite the actuating button. A momentary pressure of four ounces on the actuating button opens the contact circuit which remains open after the pressure is removed until the manual reset button re-establishes the normally closed circuit.

Engineering Dept. Equipment

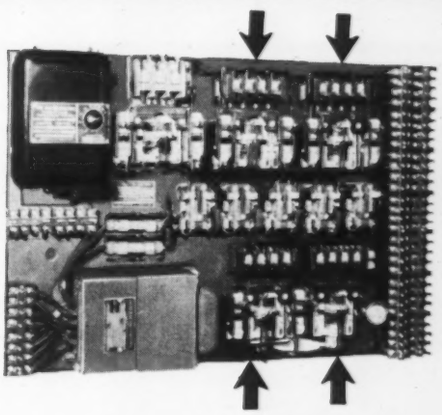
Portable Printer Announced

TO USE positive printing, dry developing Ozalid sensitized papers and cloths, a new Elpro portable printer is announced by the Ozalid Corp., Ansco road, Johnson City, N. Y. It will reproduce any pencil or ink lines, typewritten or printed matter appearing on one

ON THE MACHINE—



OR IN THE MACHINE—



The New 'D50

Is in Its Element

"DESIGN us a starter for small motors that will be well suited to use on machine tools." That was the instruction that resulted in the development of the new CR7006-D50. That is why it is a machine-tool starter all the way from its efficient, long-lived, three-leg solenoid magnet to the Flamenol wiring that is oil-resisting.

When you design a machine embodying motors up to the sizes listed below, you'll assure its dependability in the field by specifying the CR7006-D50 starter for its control.

RATING OF THE NEW STARTER

	110 v	220/550 v
Single-phase	1 hp	1½hp
Three-phase	1½ hp	2 hp

General Electric, Section 676-5B
Schenectady, N. Y.
Please send me complete data on the new CR7006-D50 magnetic starter (GEA-3250).
Name.....
Address.....
City.....*State*.....
676-5

GENERAL ELECTRIC

There's a G-E TIME SWITCH for Every Purpose

TYPE TSA-10 *for*

Accurate, Adjustable INTERVAL TIMING

In manufacturing processes where accurate, *interval* timing is an important factor, this time switch can help you make savings in workmen's time, reduce waste and spoilage, and increase product uniformity.

WIDELY ADAPTABLE

The Type TSA-10 is an automatic switch for the control of machines or processes where accurate timing is extremely important. It will provide time-delay opening or closing of a contact and then reset, or hold the contact closed (or open). It provides adjustable, automatic control of "Open" or "Closed" time, control of starting time, or of the interval of consecutive processes.

TYPICAL APPLICATIONS

This time switch can be used to control hydraulic presses, tire molds, plastics molds, photographic printing machines, paint mixers, signaling devices, and many other machines.

For further information call the nearest G-E Office or write for bulletin GEA-1771. General Electric, Schenectady, N. Y.

G-E TIME CONTROL DEVICES

General-purpose switch—Send for GEA-1427 | For interval timing—Send for GEA-1771 | For cyclic timing—Send for GEA-2963 | Electric time meter—Send for GEA-3299

GENERAL ELECTRIC

609-2

side of a reasonably translucent sheet. The light source consists of six specially developed lamps. Case is finished in attractive gunmetal, and a highly polished aluminum reflector assures uniform light distribution over the printing surface. A new feature is a dry developing chamber, conveniently located behind the metal reflector, utilizing the heat generated by the lights to vaporize the developing agent. A time switch allows the operator to regulate automatically the length of exposure, eliminating guess work.

Drawing Table Comes in Six Sizes

MADE in six top sizes, a new type drawing table is announced by Hamilton Mfg. Co., Two Rivers, Wis. The drawing board may be instantly set at any angle from horizontal to full vertical by closing the release mechanism at the left side of the board and then tilting the board. Height of the board is adjustable from 33½ to 42 inches and is controlled by four handwheels in each of the tubular steel legs. Where frequent height changes are necessary an

Drawing board may be set instantly at any angle by closing release mechanism on drawing table

auxiliary gear-raising device operated by a crank is available. Welded steel tubing is finished in satin chromium and there is a comfortable 5-inch wide foot rest running the entire width of the table, 47 inches. An auxiliary reference surface equipped with a tool drawer is also available and is mounted on the back of the table.

Tracing Medium Used with Pencil

NOT a tracing cloth and not a vellum, a new transparent tracing medium announced by The Frederick Post Co., Box 803, Chicago, is used with hard drawing pencils and gives drawings with a solid background and sharp white lines of ink-like opacity. On Blacline prints the detail is solid and sharp, the background uniformly white. Further advantages claimed for this medium are unusual strength and body. The back or reverse side is protected from dust by the ice-glazed surface, while the front side is moisture-proof. Standard rolls are 20 yards long, 30, 36, 42 or 54 inches wide, available in plain or printed sheets. A factual sample kit will be sent on receipt of requests.

Linen Reproduces from Pencil Drawing

A SENSITIZED linen that will reproduce a master positive copy from a pencil drawing for use like a tracing, has been brought out by Hunter Electro-Copyist Inc., Syracuse, N. Y. This copy is made by contact photoprinting in ordinary office light. Tradename

of the linen is Heccotex and it is properly sized and waterproofed to take an office-light emulsion with a nonhalation backing. It is also possible to make Heccotex reproductions from old, worn-out tracings, and surface stains and wrinkles are no obstacle to clear reproduction. Heccotex tracing linen is available in sizes 12, 18, 24 and 36-inch rolls.

Two Drafting Tables Announced

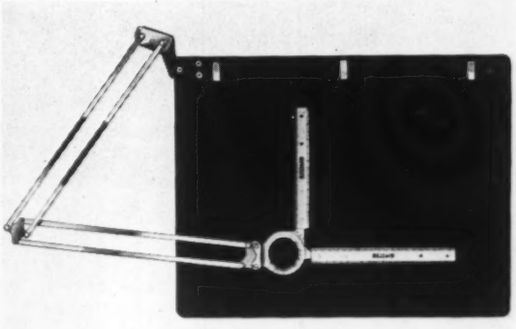
TWO drafting tables, one of which is illustrated, are being offered by the Frederick Post Co., Hamlin and Avondale avenues, Chicago. Neat in appearance, these tables in addition have easy adjustment. The Primo Metapost has a free-operating handwheel that will raise the working surface from 35½ to 43 inches. From front to back, this table may be tilted at an angle of sixty degrees by the manual

Drafting table may be tilted by manual adjustment of two hand clamps and working surface is raised equally easily

adjustment of two clamps. The Metapost has the same adjustment features except that its top is raised by loosening two thumbscrews on the uprights supporting the table top. Both tables are built of attractive satin chromium tubular steel, in pleasing contrast to the baked, black morocco castings.

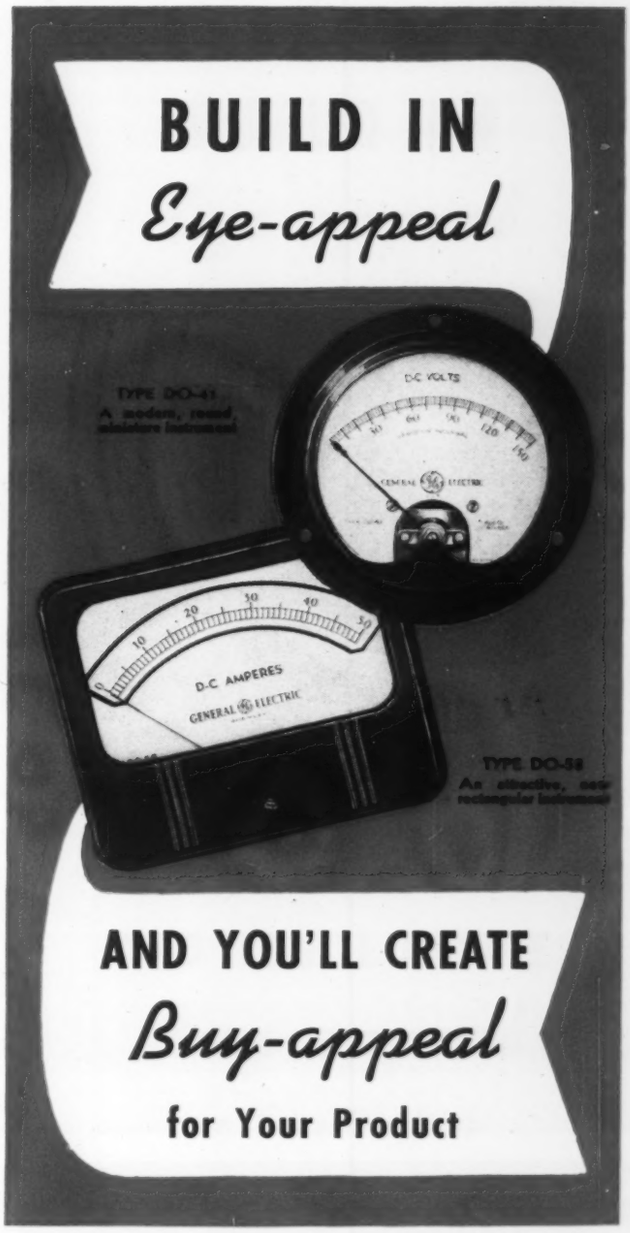
Drawing Machines Finely Graduated

TWO new series of drawing machines, comprising seven models, have been placed on the market by the Drafto Co., Cochranton, Pa. The protractor is stainless steel with accurate graduations. With the



By means of vernier on back plate of drawing machine, small graduations may be set

vernier attached to the back plate it is possible to set the machines to one-half degree. Protractor may be latched accurately at 0, 30, 45, 60 and 90 degrees either side of zero.



YOU will add to the attractiveness of your machines if you equip them exclusively with General Electric instruments. They are carefully designed to enhance the appearance of apparatus in which they are incorporated.

Then too, G-E instruments are accurate, reliable, and built to give years of long, hard service. Any way you look at it, they can be a hard working factor in giving more buy-appeal to the products you manufacture.

A full line of standard instruments in all shapes and sizes is available. It will pay you to put your instrument problems up to the nearest G-E office. General Electric, Schenectady, N. Y.

GENERAL ELECTRIC

FLAMENOL

REG. U.S. PAT. OFF.

WIRE

SMALLER SIZE

OLD

NEW

The "OLD" is a No. 10 Awg Flamenol wire with 3/64-inch wall. The "NEW" is a No. 10 Awg Flamenol wire with 2/64-inch wall. Both approx. actual size

. . and

LOWER PRICES

FOUR sizes of Flamenol wire are now available with thinner walls. They are No. 14, 12, and 10 with 2/64-inch (instead of 3/64) and No. 8 with 3/64-inch (instead of 4/64). These are listed by the Underwriters' Laboratories, Inc., for the same uses as the heavier-wall sizes. See Bulletin GEA-2733 for details.

These smaller sizes, of course, lead to savings in space. But they also mean lower prices—about 15 per cent lower. Recent price reductions on all sizes bring the total reduction on these four sizes to some 25 per cent.

Before making this announcement we built up stocks; so you can get prompt shipment on most standard sizes. Address nearest G-E Office or General Electric Company, Schenectady, N. Y.

GENERAL ELECTRIC

600-18

Meetings and Expositions

Aug. 19-23—

National Association of Power Engineers. Annual meeting to be held at the Deshler-Wallick hotel, Columbus, O. Fred W. Raven is secretary, 176 West Adams street, Chicago.

Aug. 26-30—

American Institute of Electrical Engineers. Annual meeting to be held at Ambassador hotel, Los Angeles. H. H. Henline, 33 West Thirty-ninth street New York is secretary.

Sept. 3-6—

American Society of Mechanical Engineers. Fall meeting to be held at Spokane, Wash. C. E. Davies, 29 West Thirty-ninth street, New York, is secretary.

Sept. 10—

National Association of Ice Refrigerator Manufacturers. Annual meeting to be held at Sherman hotel, Chicago. H. L. Covert, 310½ Broadway, Abilene, Kansas, is secretary.

Sept. 15-21—

Twenty-fourth Annual Eastern States exposition to be held in Springfield, Mass. Additional information may be obtained from J. H. Fifield, Eastern States Exposition, Springfield, Mass.

Sept. 16-19—

American Mining Congress. Annual metal mining convention and exposition to be held at Colorado Springs. Julian D. Conover, 309 Munsey building, Washington, D. C., is secretary.

Sept. 18-20—

National Industrial Advertisers association. Annual meeting to be held at the Hotel Statler, Detroit. Miss M. R. Webster is headquarters secretary, 100 East Ohio street, Chicago.

Sept. 24-25—

Society of Automotive Engineers Inc. National Tractor meeting to be held at Schroeder hotel, Milwaukee. John A. C. Warner, 29 West Thirty-ninth street, New York, is secretary and general manager.

Sept. 24-27—

Association of Iron and Steel Engineers. Annual meeting to be held at the Stevens hotel, Chicago. Brent Wiley, 1010 Empire building, Pittsburgh, is managing director.

Oct. 12-19—

National Dairy association. Meeting and exposition to be held at Harrisburg. Lloyd Burlingham, 308 West Washington street, Chicago, is secretary.

Oct. 16-18—

Porcelain Enamel institute. Annual meeting to be held at University of Illinois, Urbana. C. S. Pearce is secretary, 612 North Michigan avenue, Chicago.

Oct. 17-19—

American Society of Tool Engineers. Semiannual convention scheduled for Cincinnati. Additional information may be obtained from Ford R. Lamb, 2567 West Grand boulevard, Detroit, executive secretary.

Oct. 17-23—

Wire Association. Annual meeting and exhibition to be held at Carter hotel, Cleveland. Richard Evan Brown, 300 Main street, Rooms 609-13, Stamford, Conn., is secretary.

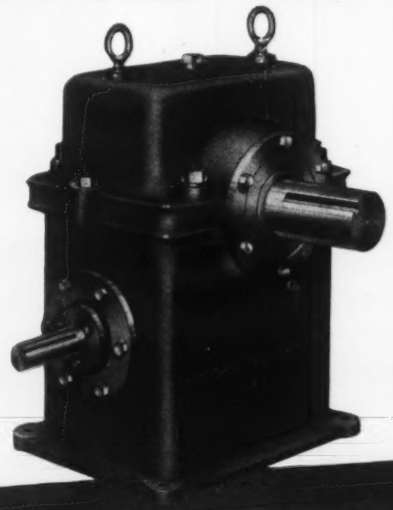
Oct. 20-25—

American Welding Society. Annual meeting and exposition to be held at Hotel Cleveland, Cleveland. Miss M. M. Kelly, 807 Riverside Drive, New York, is secretary.

Oct. 21-25—

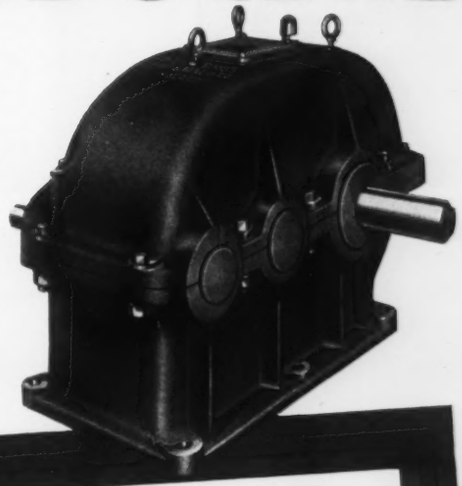
American Society for Metals. Annual meeting to be held at the Hotel Statler, Cleveland. W. H. Eisenman is secretary, 7016 Euclid avenue, Cleveland.

IXL SPEED REDUCERS

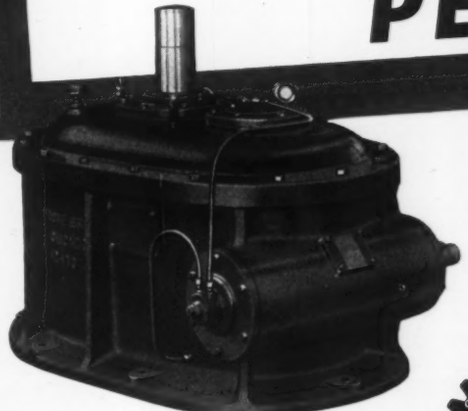


Left—An IXL "Hygrade" type HGS. One of a broad range of worm reducers available in single and double reduction, horizontal or vertical drives.

Right—A typical heavy duty IXL "Titan." Made in single and double reduction up to 300 H.P. Ratios from 2.87 to 1 up to 96.2 to 1.



for DEPENDABLE TROUBLE-FREE PERFORMANCE



Above—Type AD double reduction heavy duty agitator drive. Ideal unit for vertical agitators in process industries. Slow speed shafts from ½ to 35 r.p.m. with motor speeds from 1200 to 1800 r.p.m. Capacities from 10 to 60 h.p.

IXL
The Mark of Quality

Above—IXL type HGM Radiating Worm Powered Gear. Heavy duty, high efficiency. Slow speed shaft range from 13 r.p.m. to 538 r.p.m. Capacities from ¾ to 40 h.p.

ASK ABOUT

IXL "FIVE-POINT" Deephard STEEL

If you want increased wear life without sacrificing strength and ductility, look into Five-Point Deephard Steel products manufactured by Foote Bros.

FOOTE BROS.
GEAR AND MACHINE CORPORATION
Established 1859

5303 SO. WESTERN AVE., CHICAGO, ILL.

A complete line of speed reducers, powered gears, special drives and gears of all kinds.

SEND FOR THIS TODAY!

Send for this valuable 600 page handbook, "Gear Problems". Free to executives and engineers.

TRACING CLOTH
MUST HOLD AND PROTECT
THE BEST IDEAS OF
HIGHLY TRAINED MEN

OUR TRACING CLOTHS
ARE MADE TO BE
WORTHY OF THIS
IMPORTANT TRUST

THE FINEST MATERIALS

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Professional Viewpoints

(*Continued from Page 61*)

a "stress relief factor," F, where,

$$F = S_a/S_t \quad \ldots\ldots (6)$$

determining S_a, the criterion of failure by

$$S_a = FS_t \quad \ldots\ldots (7)$$

Investigation should be directed toward finding the laws of variation of F which, since it is more fundamentally based, should be more consistent with experimental data than q.

$$F = [1 + (K_1 - 1)q]/K_t \quad \ldots\ldots (8)$$

As an example of this usage, the value of $F = .75$ was used for the part shown in *Fig.* 17 (scale ½ size), "Photoelastic Analysis in Commercial Practice" in May issue of MACHINE DESIGN. Note that the calculation of an S_n on this part is impossible.

It would seem probable to the writer that F could be related to the maximum shear stress gradient at the surface, in the two directions, as follows:

$$F = 1 - CD_yD_x \quad \ldots\ldots (9)$$

where D_y is the derivative of the maximum shear stress variation, i.e., the "gradient," perpendicular to the boundary, D_x the gradient parallel to the boundary, and C a factor depending on the material and its metallographic condition.

The foregoing can be seen to be a variation of the suggestion made in Peterson's paper for determining "q". It may also be, as he suggests there, that grain size should be incorporated in (9).

It is interesting to see how this works out in few simple cases. In simple tension both D_y and D_x would be zero, and $F = 1$, or no relief occurs. In a beam in uniform bending $D_x = 0$, and $F = 1$. In a simple beam with a concentrated load both D_x and D_y would have a small value, indicating a very small relief.

The writer would appreciate the reader's comments on this matter as he believes the need for the evaluation of stress relief is due for a growing recognition as more general evaluation of stress peaks are made by elastic theory, photoelastic analysis, etc.

—R. E. ORTON, Chief Engineer, Tool Div.
Acme Steel Co.

To the Editor:

REFERRING to Mr. Orton's suggestion that F be taken as $(1 - C\,D_y\,D_x)$ in Equation 9, the writer does not believe that this may be used without modification. For example, in the important practical case of shaft fillets or grooves in bending, at the point of maximum stress the stress gradient D_x parallel to the boundary is zero. The formula would then yield $F = 1$ for all shaft fillets or grooves which, of course, is not the case.

—A. M. WAHL

To the Editor:

REFERRING to Mr. Orton's discussion of Dr. Wahl's article, the writer does not agree that nominal stress has "no real or theoretical meaning." Suppose we have a beam, illustrated at a in the ac-

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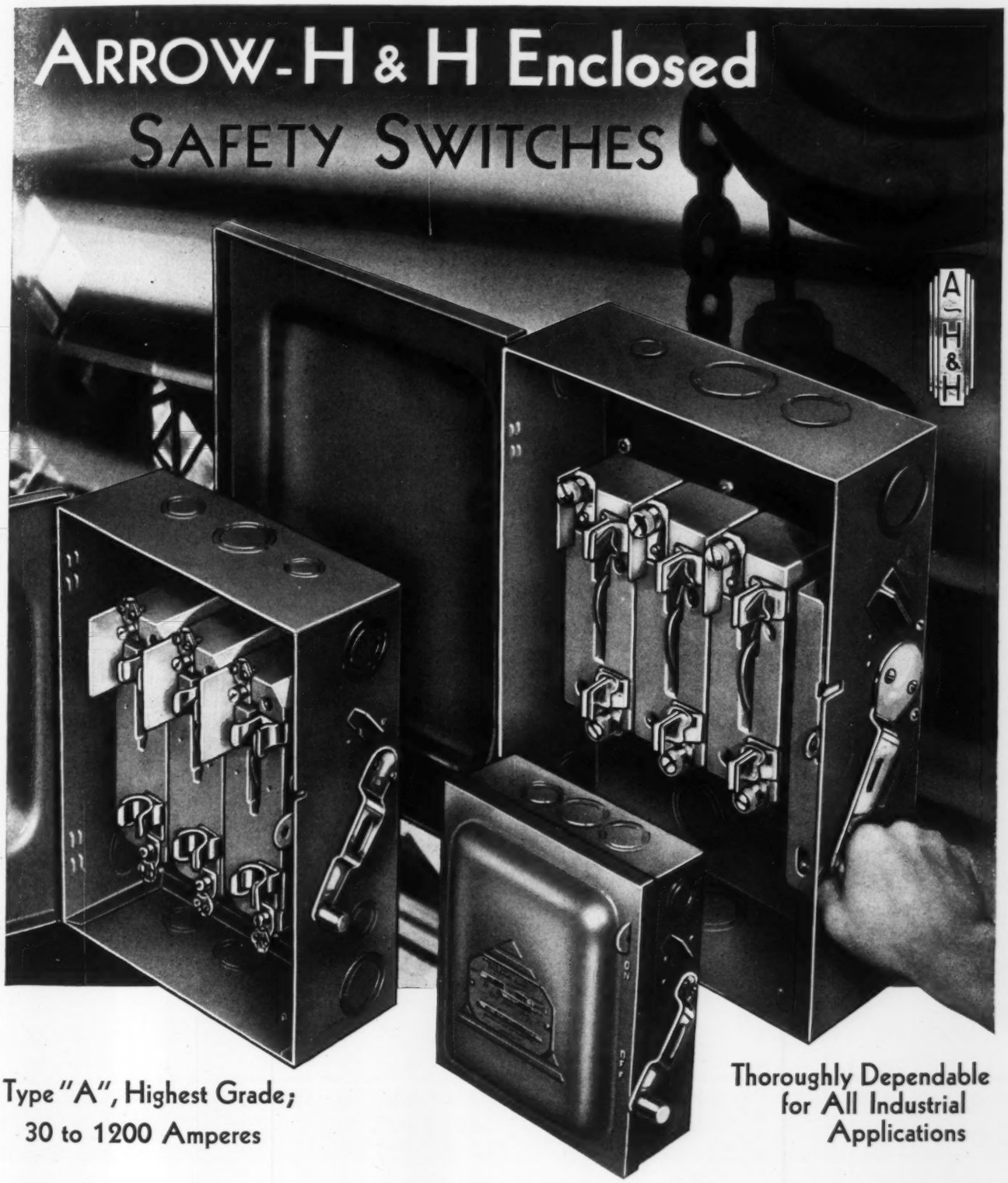

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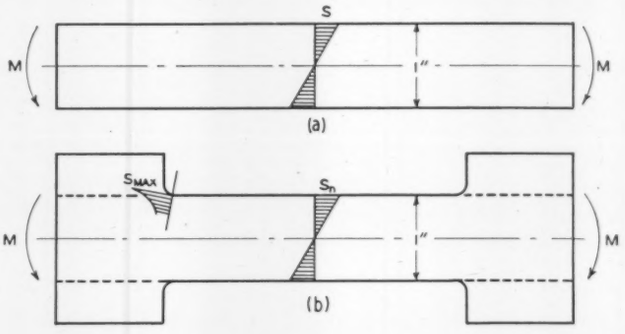
companying drawing, acted on by bending moments M giving a stress S. Let us now add material to produce a filleted member as at b. The stress in the midportion is the same as before and we will call this S_n. Due to creating a change of section a peak stress occurs which we will denote S_{max}. The stress concentration factor $K = S_{max}/S_n$ represents the ratio of increase of stress due to introducing the "stress raiser," in this case a fillet, but applying equally well to the



case of a hole, notch, keyway, threads, etc. In these cases it is clear that nominal stress has a real meaning.

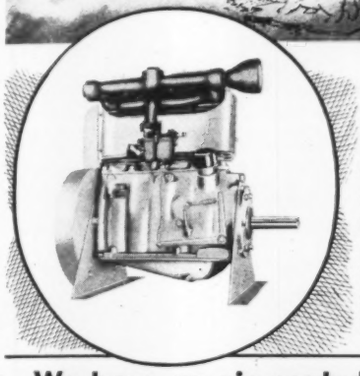
It is, of course, possible to find cases where nominal stress has *no* meaning. It has been our experience that as far as design application is concerned, such instances are the exception rather than the rule and we treat them as such. A wide usage of nominal stress and stress concentration factors exists in books, data sheets, etc. and although Mr. Orton "believes that nominal stress should be forgotten," it is safe to say that generally speaking this is not likely to happen.

Granting that one is willing to use these terms, it is of interest to compare the "sensitivity index" q and the "stress relief factor" F. The latter is defined by Equation 6 of Mr. Orton's discussion as $F = S_a/S_t$. From Equation 3, $S_a = K_f S_n$ and from 2, $S_t = K_t S_n$. Therefore $F = K_f/K_t$. This is to be compared with $q = (K_f - 1)/(K_t - 1)$ as to suitability for correlation of fatigue data. Suppose we have available the data given by the first two columns of the Table, the K_f values being for two sets of fatigue specimens, each set consisting of geometrically similar specimens varying in absolute size. A very small but sharp notch will have a high K_t factor but a K_f approaching 1. The q index in the limit approaches zero in both cases, whereas F

K_t	K_f	q	F
4	3.70	.900	.925
4	2.00	.333	.500
4	1.04	.013	.260
2	1.90	.900	.950
2	1.50	.500	.750
2	1.02	.020	.510

approaches ¼ and ½ for the same physical phenomenon, i.e., no notch effect. It seems to the writer that an index which ranges from zero (no notch effect) to unity (full theoretical effect) is a logical one for comparing a wide variety of stress concentration effects.

—R. E. Peterson, Manager, Mechanics Dept.
Westinghouse Research Laboratories



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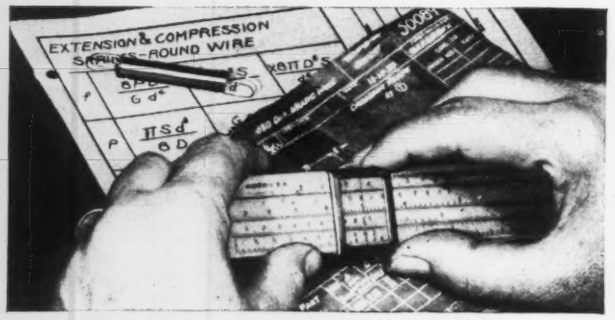

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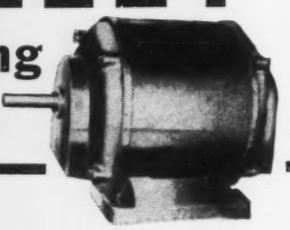

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Differential Gearing Protects Mechanisms

(Concluded from Page 50)

operating arm is associated with the shoe and will be moved with the bevel gear through the gear train in order to compensate for movement of the rack gear at the opposite end of the gear train. The end gears have opposite bevel teeth so that the movement of the intermediate gears is merely idle and compensatory, thus acting as a differential gear mechanism.

To provide protection against damage or breakage to the knife operating parts and driving mechanism an automatic slip clutch with multiple dry disks is utilized on the pitman flywheel. Construction and operation of this clutch is apparent from an examination of *Fig.* 5.

Also a safety swing back is provided to allow bar, shoe and support to swing back substantially 45 degrees from normal operating position when a stake, rock, or other unyielding obstruction is hit as in *Fig.* 2. Bar is returned to and held in cutting position by a heavy adjustable tension spring of sufficient strength for normal cutting, yet providing a shock-absorbing cushion which prevents damage to bar and supporting frame when unyielding obstructions are encountered.

The center of travel of ball-end extension on gear housing is substantially on the pivotal center of the swing plate bracket. Consequently the power take-off does not have to be disengaged to allow the bar to swing back when an unseen obstruction is encountered by the bar. The knuckle joint shown in *Fig.* 5 prevents binding of pitman rod.

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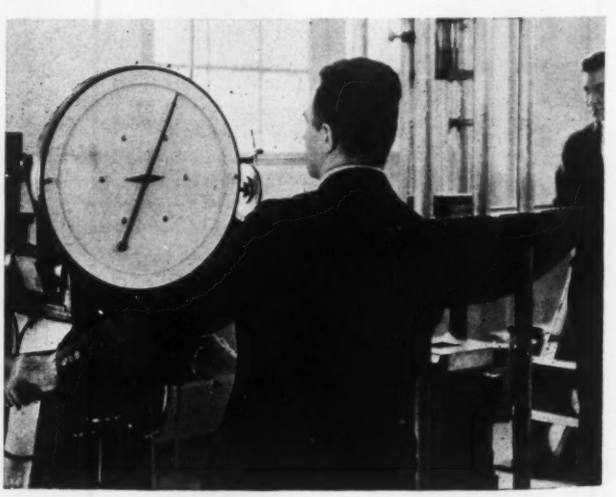

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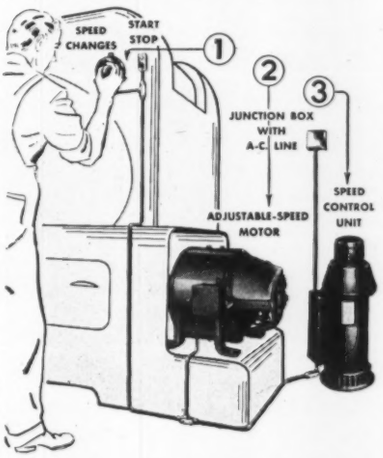

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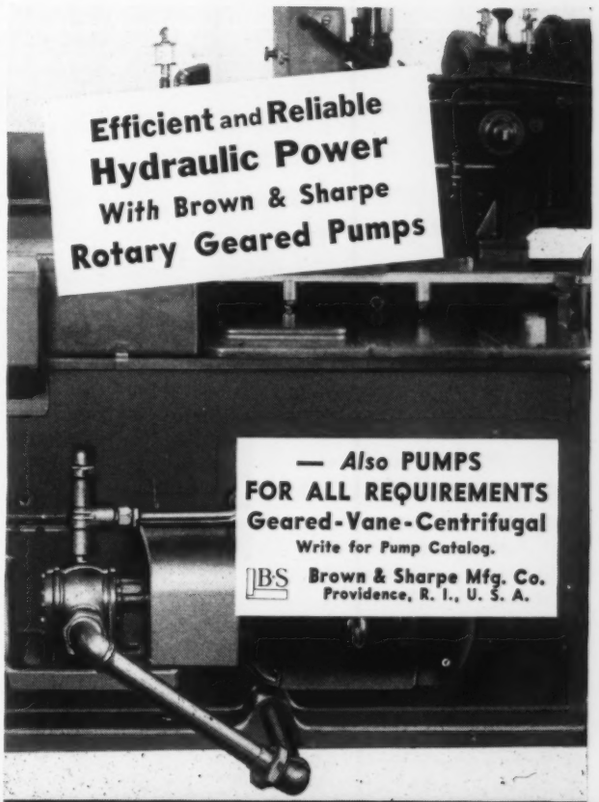

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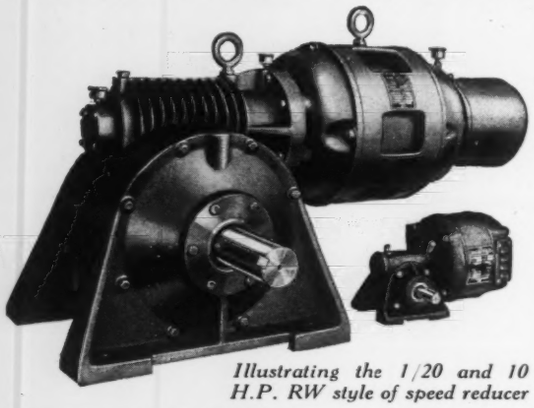

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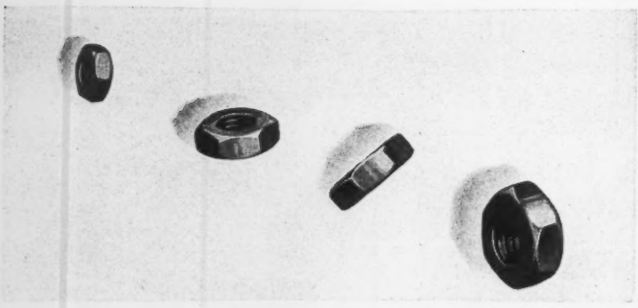

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Business and Sales Briefs

In his new capacity as exclusive factory representative for eastern Michigan for McKenna Metals Co., Latrobe, Pa., John S. Roney will handle sales of Kennametal. His headquarters will be at 14425 Mark Twain avenue, Detroit. Mr. Roney was for some time connected with American Rolling Mill Co. and later with Foote Bros. Gear & Machine Corp.

♦

Announcement has been made by Allegheny Ludlum Steel Corp. of the appointment of Peden Iron & Steel Co., Houston, Texas. A comprehensive stock will be carried from which shipments can be made promptly. Another appointment, that of Murray-Baker-Frederic Inc., New Orleans, La., has been made by the company to cover the area comprising Louisiana, the larger portion of East Texas, and the southern portion of Kansas.

♦

Another plant of the S K F Industries Inc., Philadelphia, has been opened which is said to increase the capacity by more than 6000 types and sizes of ball and roller bearings. The plant, one of the most modern in Philadelphia, is located on the Pennsylvania railroad at Bridge street, and will be devoted exclusively to the manufacture of antifriction bearings.

♦

George Campbell will succeed George H. Calkins who has retired after more than forty-one years of service with General Electric Co. Mr. Calkins was formerly manager of the Buffalo office of the company. Mr. Campbell, the new Buffalo office manager, was formerly connected with the Schenectady office of the company. Other appointments announced are those of Ralph M. Darrin of Buffalo as manager of the Syracuse office, E. H. Aussicker of Binghamton as manager of the Schenectady local office, and E. B. Currie of Rochester as manager of the Binghamton office.

♦

L. G. Barnes of the Chicago district sales office of Universal Gear Corp., Indianapolis, has been made manager of the Chicago office and will have direct supervision of all sales offices in the states of Illinois and Iowa. Mr. Barnes will be located at 600 South Michigan avenue (Room 909), Chicago.

♦

Chain Belt Co. has announced the appointment of G. B. Flanigan as its New York district manager, succeeding the late W. H. Quinn. Mr. Flanigan was formerly Chicago district sales manager.

♦

An addition to the Waterbury Tool Co. plant on East Aurora street, Waterbury, Conn., is now under way. The plant is scheduled for completion in four weeks and will increase the company's capacity for manufacturing pumps and hydraulic speed gears. In the future the company will be known as the Waterbury Tool Division of Vickers Inc.

♦

Pittsburgh offices of Cutler-Hammer Inc. have been moved to new and larger quarters in the Park building at 355 Fifth avenue.

♦

Completion of a new acetylene plant at West Berkeley, Calif., for the Air Reduction Co. has recently been announced. It will be located a short distance from the old site and will include all modern equipment for the manufacture of acetylene, the filling, compressing and handling of cylinders.

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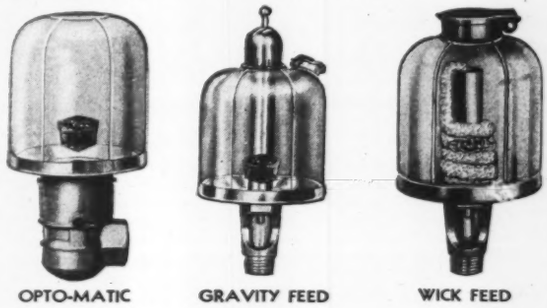

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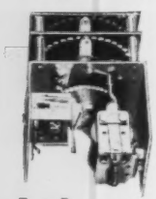

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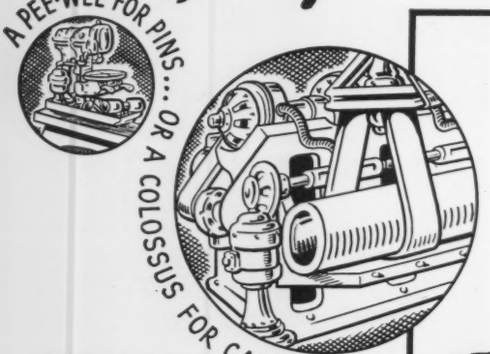
Applied to the automatic phonograph industry, Relays by Guardian helped solve this perplexing problem—not once—but in half-a-dozen different ways, each fitted to the individual manufacturer's product. Your control problem may be tougher, but chances are 99 out of 100 Guardian will solve it. Write for new catalog on your letterhead today.

GUARDIAN ELECTRIC

1621 W. WALNUT STREET CHICAGO • ILLINOIS

What's your problem?

A PEE-WEE FOR PINS ... OR A COLOSSUS FOR CANNON....



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Ruthman engineers are available to help you solve your coolant problems. Simply write giving us the facts. We'll do the rest.

All Gusher models are precision-built, ball-bearing, quiet, self-cleaning and hydrostatically balanced.

THE RUTHMAN MACHINERY CO.
540 E. FRONT ST., CINCINNATI, OHIO
LARGEST EXCLUSIVE BUILDERS OF COOLANT PUMPS

Calculating Stresses in Engine Parts

(Continued from Page 55)

cross-sectional shapes with the long axis of the I-beam in the plane 90 degrees to crankshaft centerline. On some types and sizes of engines where a low rate of production does not warrant the expense of dies for forging the I-beam section it is more economical to use one of the other two shapes, either round or rectangular.

A lightweight design that caused considerable difficulty in broken bolts due to deflection of the rod foot is shown in *Fig.* 5. Comparison of *Fig.* 5 with *Fig.* 1 will show the great gain in stiffness in the latter design with only a slight increase in weight, the increase in stiffness being in the ratio of approximately 4.5 to 1. The type of design shown in *Fig.* 1, which is now more widely used, has eliminated crank-bolt breakage previously caused by bending due to deflection of the crank end of the connecting rod. It can also be shown by mathematics that because of centrifugal force of the rotating end of the connecting rod applied outward, when crank and connecting-rod centerlines are approximately 90 degrees to each other ,the deflection of the design shown in *Fig.* 5 will cause a bending stress in the bolts of approximately 34,000 pounds per square inch. Adding to this the direct tensile stresses on the bolts we find the actual working stress is practically at the endurance limit of the material, accounting for the failures.

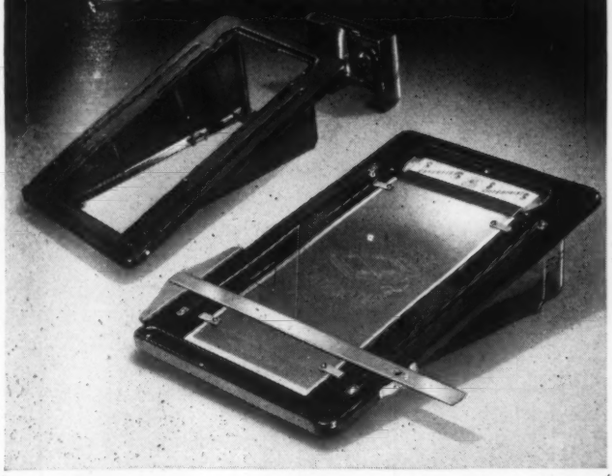
Figuring Bearing Cap Stresses

CONNECTING-ROD BEARING CAPS: Regardless of the shape proposed for the cross section of the connecting-rod bearing cap, the cap stress should be determined by the most severe consideration in order to gain rigidity. It is not practical to state what definite deflections should be permitted, because the ideal would be zero and the limiting value is determined by good performance experienced. The simplest method of gaining rigidity is to consider the cap as a freely supported curved beam. Supports are at the crank bearing bolt centerlines and the maximum load applied to the center of the cap as concentrated load. Actual total load in all crank bearing bolts obtained from a study of the forces (inertia forces and others) can be this concentrated load. Again I-beam cross sections give the most strength and rigidity with the least weight.

Bending moment on the beam is the simple beam formula

$$M = PX/2 \quad \ldots\ldots\ldots\

PLASTIC MOLDED
SPEED-O-SCOPE



The use of molded plastics instead of wood and metal reduced the weight, lowered the production cost and improved the appearance of the Speed-O-Scope.

For large, precision parts molded of plastics, write—

CHICAGO MOLDED PRODUCTS CORP.
1028 North Kolmar Ave. Chicago, Illinois

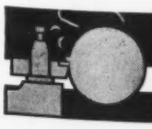
3 DESIGN PROBLEMS

- Reduce Weight
- Increase Strength
- Cut Production Costs

Quickly Solved by KENNAMETAL Steel-Cutting TOOLS

If high machining costs have prevented you from using high tensile steel to reduce weight and increase strength, it will pay you to investigate KENNAMETAL steel-cutting tools. For KENNAMETAL machines steel of all hardnesses up to 550 Brinell, *without previous annealing*, at greatly increased cutting speeds and with far more pieces per tool grind.

A KENNAMETAL engineer will gladly confer with you, and your plant superintendent, to show how KENNAMETAL permits you to design a better product while cutting production costs. There is no obligation—write today.



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LATROBE, PENNSYLVANIA, U.S.A.

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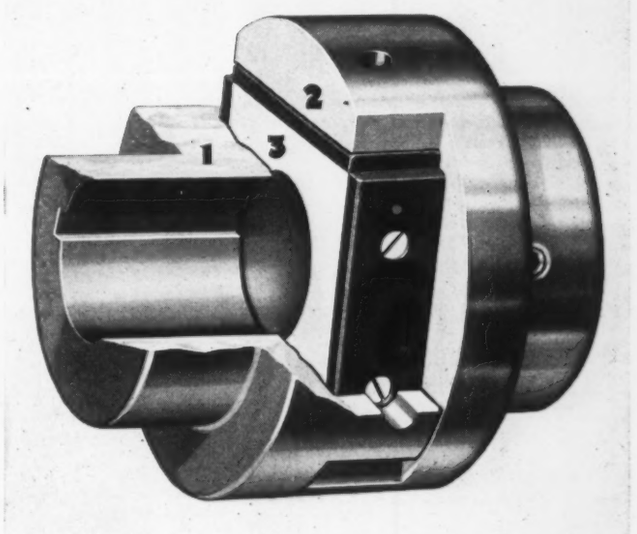
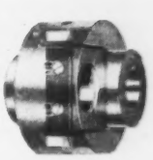
American Flexible Couplings
HAVE ONLY 3 SIMPLE–RUGGED PARTS
2 identical jaw flanges—1 floating center block





● The buyer of your equipment gets added assurance that he'll get *all* the high machine output at the low cost he's after, when you incorporate a simple, rugged, soundly engineered coupling—the American Flexible Coupling. In this coupling, the flexibility comes from the design—which is based on a new application of the proven Oldham Principle—not from flexible materials. The floating metallic center block (3) being free to float in any direction between the jaw flanges (1 and 2) compensates for misalignment without sacrificing precision of movement.

First cost and upkeep is low. Inexpensive and easily replaced non-metallic wearing strips on the load bearing surfaces of the floating metallic center block absorb the wear. For more information write to

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(Trade Name Reg. U. S. Pat. Off.)
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AMERICAN FLEXIBLE COUPLINGS *provide complete flexibility without flexible materials*

Write for REVISED 44 PAGE ENGINEER'S DATA BOOK also new enlarged vapor pressure-temperature chart.

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METALLIC BELLOWS

HYDRON Metallic Bellows are used as control elements in temperature-and-pressure-control devices, and for liquid or gas seals of compressors and pumps. We are specialists in the design and production of complete thermostatic and pressure units for temperature and pressure controls. We are, therefore, prepared to extend the fullest co-operation to engineering departments of control manufacturers in the solution of design and engineering problems.

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BOSTON CHICAGO DETROIT LOS ANGELES

PRODUCERS OF BELLOWS EXCLUSIVELY
SERVING AUTOMATIC CONTROL MANUFACTURERS

Prepared!··

We're prepared — you won't catch us napping. We've been tooling up for several years — new machine shop in 1938 — new addition in 1940 — a new, larger steam hammer just being completed — upsetting machines — more drop hammers — even under pressure we can maintain the kind of service on forgings to your exact specifications that has made Kropp the World's Largest Job Forging Shop.

Shoot us your blueprints and we'll fire back the forgings — rough, semi-finished or completely machined ready for assembly!

Typical aircraft forgings on which orders were executed in record time—from blueprint to shipment.

KROPP FORGE COMPANY

World's Largest Job Forging Shop

5307 W. ROOSEVELT ROAD, CHICAGO, ILLINOIS

Representatives in Principal Cities

given in *Fig.* 4 for various types of cross sections[3]. Thus the stress at the section being considered is

$$S_b = KMc/I \quad \ldots\ldots (8)$$

where S_b = bending stress, pounds per square inch; M = bending from equation (7); c = distance from neutral axis to the extreme fiber on the side (tension or compression) being considered, inches; I = cross-sectional moment of inertia, inches; K = correction factor for curvature of beam and is a variable depending on the shape of the cross section and also on R/c_1 where R = radius of curvature of path of neutral axis at the point where the cross section is being studied and c_1 = distance from neutral axis to the extreme fiber on the concave side of the curved beam.

Thus for a connecting-rod cap with a load P on the concave side we have

$$S_b = K_1 Mc_1/I \quad \ldots\ldots (8a)$$

pounds per square inch compression on the inner fiber, and

$$S_b = K_2 Mc_2/I \quad \ldots\ldots (8b)$$

pounds per square inch tension on the outer fiber. In these equations K_1 = correction factor for inner fiber; K_2 = correction factor for outer fiber; c_1 = distance to inner fiber, inches; and c_2 = distance to outer fiber, inch. Both K_1 and K_2 are given in *Fig.* 4 for the determined value of R/c_1 for a definite section shape.

By referring to *Fig.* 1 a better tie-in of the foregoing method to solving an actual problem is apparent. Various cross sections of the cap should be analyzed for stress in the same manner. At section *CC* in *Fig.* 1 note that there is a small radius where a flat is milled to prevent the head of the crank bearing bolt from turning. Even if this radius is made as generous as possible, the tension stress at this point should be increased by 50 per cent to allow for stress concentration due to this fillet.

PISTON RODS FOR CROSSHEAD-TYPE ENGINES: The actual load on the piston rod, both in compression and tension, should be determined by a careful analysis of all the forces occurring during the engine's cycle. Piston rod stresses in compression should also be determined by using Rankine's formula for short columns. The column should be considered fixed at the cross-head end and rounded and free at the piston end, giving the following formula

$$S_c = (P/A)[1 + .000078(l/r)^2] \quad \ldots\ldots (9)$$

where S_c = column stress, pounds per square inch; P = total thrust load on the rod, pounds; A = cross-sectional area of the rod, square inches; l = length of the piston rod from the centerline of the crosshead to the centerline of the piston boss, inches; r = radius of gyration of the cross section of the rod, inches. For solid circular rods $r = d/4$, while for hollow circular rods

$$r = \frac{\sqrt{d^2 - d_1^2}}{4}$$

where d = outside diameter, inches and d_1 = inside diameter, inches.

[3] *Fig.* 4 is reproduced from Seely's results given on pages 5 to 34 of Eshbach's *Handbook of Engineering Fundamentals.*

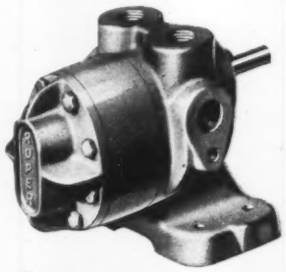
We're Not Fishing for Compliments . . .

. . . but we're getting them since the new Hydraulically Balanced Ropers have been installed in numerous plants.

Users are reporting the smoothest pumping jobs they have ever witnessed . . . and you will get exactly the same results when you install these new improved pumps.

Write today for Catalog No. 932 . . . it's full of factual pumping information in addition to a complete description of the new Roper line.

Write for your copy TODAY!



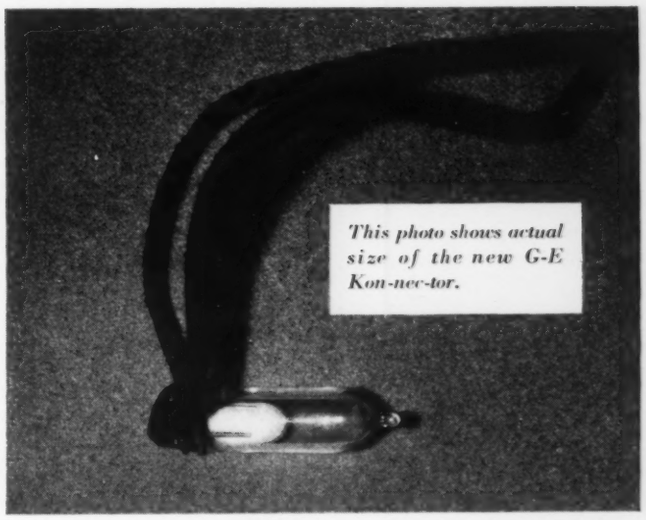
HYDRAULICALLY BALANCED

ROPER

Rotary **PUMPS**

DEPENDABLE SINCE 1857

GEO. D. ROPER CORP., ROCKFORD, ILL.



This photo shows actual size of the new G-E Kon-nec-tor.

General Electric announces

A NEW SMALL SIZE G-E KON-NEC-TOR LISTING AT 20c

GENERAL ELECTRIC offers the designers of electrical machinery a brand new small size G-E Kon-nec-tor . . . an all glass mercury switch with 5 amperes continuous current capacity that *lists at 20c complete with lead wires and at only 15c without lead wires!*

The price and capacity of this new mercury switch make it particularly adaptable to the design of many kinds of electrical machinery such as animated window displays, or as an automatic door switch on mechanical refrigerators, and on the glove and luggage compartments on automobiles.

Like other types of G-E Kon-nec-tors, this new small size mercury switch is a safe, dependable, long-lived contact device. Because of its patented construction, it may be operated millions of times with unvarying efficiency. For further information, write or wire.

HERE ARE OTHER TYPES OF G-E KON-NEC-TORS

These simple, modern, electric switches are corrosion-proof, flash-proof, and dust-proof. Adaptable to the design of all kinds of electrical machinery, they provide positive make-and-break of the electrical circuits involved.

NELA SPECIALTY DIVISION, LAMP DEPT.

GENERAL ELECTRIC

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SpeedWay
Motorize your products or make them Automatic with SpeedWay Motors
DEPENDABLE 110V MINIATURE MOTORS . . . types that exactly meet the requirements of a hundred different jobs . . . A.C., D.C. or Universal. Cased or skeleton types, with or without back gears . . . any speed or torque. Hundreds of thousands in use.
LOW COST . . . produced in great quantities by modern volume production methods, these reliable little motors are surprisingly inexpensive.
TECHNICAL SERVICE . . . state your problems, we'll give you our answer with prices, quotations, and possible delivery dates.
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Write for Motor Sheets
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or Universal
SPEEDWAY MFG. CO., 1858 So. 52nd Ave., Cicero, Ill.

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WINFIELD H. SMITH

OUR EQUIPMENT IS KEPT UP-TO-DATE IN EVERY RESPECT

The consistently high ACCURACY of WHS worms, worm gears, spurs and helical gears is due in part to the modern equipment in our plant.

Add to this factor of *efficient production machines*, the *painstaking skill* which marks all manual operations in our plant . . . . and you have the reason for WHS leadership in gear manufacturing.

Let us quote on your requirements! Especially attractive prices offered on semi-production runs of a single size.

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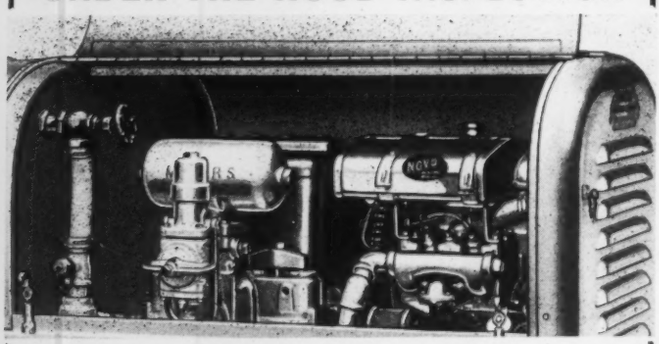
UNDER THE HOOD INSPECTION



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A good piece of machinery deserves a good power unit.

1½ to 22 HP, air- and water-cooled.

Send the coupon for full information and prices.

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Send literature and prices on NOVO ENGINES, Sizes.....
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Address .....
City ..... State .....

NOVO ENGINE COMPANY
LANSING, MICHIGAN.

Misunderstandings with Outside Inventors

(*Concluded from Page* 62)

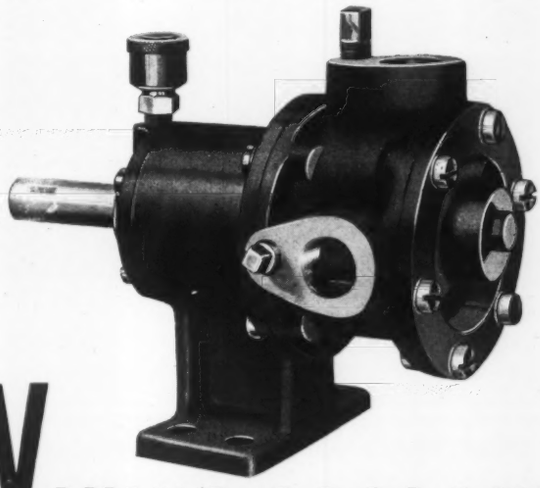
is interested in acquiring patent rights. Where there already exists a definite and clear understanding that the inventor relies solely on such rights as he has under the patent laws, there is much less likelihood of misunderstanding and consequent ill will than would otherwise be the case. If an invention seems to be of interest and patentable, negotiations for the purchase of patent rights can be started.

Handling of Nonpatentable Ideas

Sometimes a person has an idea relating to changes in products, machines or manufacturing processes of the company or to uses of its products, which he thinks is not patentable because it involves merely the skill of the artisan as distinguished from invention. Such ideas, however, rarely can be of more than nominal, if of any, value because they cannot be protected by patents and consequently as soon as the idea is put into practice competitors may copy it freely. Moreover, improvements based on the suggestions of its engineers, workmen, and other employes familiar with its work and products are constantly being adopted. The probability is great that when the time becomes ripe for the adoption of an idea of this kind it will have originated with one of the company's employes quite independently of any suggestion by one or a number of persons outside the organization. In order to avoid controversies as to the source of such an idea, its novelty or value, or as to whether or not what the company sometime may do is similar to it, the company is unwilling to consider any such idea unless it be left entirely to the company to decide what compensation, if any, shall be paid for its disclosure.

Letters concerning advertising and business ideas also seldom are of more than nominal, if of any, value to the company. Ideas of this character cannot be protected under the patent laws and trademark laws and rarely to any substantial extent under the copyright laws. The company has a large group of employes and, in addition, retains others familiar with its organization and methods constantly developing ideas of this kind, and here again controversies are likely to arise as to the source of such an idea, its novelty or value, and as to whether or not what the comany sometime may do is similar to it. Therefore, the company is willing to consider such ideas only on the basis that it be left entirely to the company to decide what compensation shall be paid.

Letters submitting ideas or inventions to the company have received and will continue to receive personal replies. A pamphlet discussing the company policy sent with such a reply will, it is hoped, make it possible to give more helpful information as to how a person may proceed in submitting an idea to the company than can readily be embodied within the compass of a personal letter of reasonable length.



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Viking's Trade Mark YOUR GUARANTEE

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"SPOT" YOUR OPERATORS WHERE THEY CAN OPERATE

TRU•LAY PUSH-PULL CONTROLS

With **TRU•LAY Push-Pull Controls** you can have variable control points from which operators can work to best advantage. The point of control can be changed at will to meet changing requirements on the job.

TRU•LAY Push-Pull Controls instantly transmit the slightest control impulse. They hold any position to which they are set.

These controls are easily installed—merely snaked around obstructions—and are easily adapted to the remote operation of valves, clutches, switches and other mechanisms. They require no maintenance attention and can't become noisy or "sloppy" in operation.

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ACCO

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Please send complete information on **TRU•LAY Push-Pull Controls.**

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WANTED: Machine Designer.

A desirable position is available with an Eastern machine tool building company for an engineer who combines a thorough training in the practice of machine design with an interest in metalworking manufacturing methods, which will enable him to develop an improved line of machines. This is a real opportunity for a man with sound engineering training and a bent for developing the art of metal manufacturing. Address Box 129, MACHINE DESIGN, Penton Bldg., Cleveland, Ohio.

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And the Companies Behind Them

(For illustrations of other outstanding machinery see Pages 58-59)

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Business

Electric writing machine, International Business Machine Corp., Endicott, N. Y.

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Sewing machine for padding lapels, etc., American Blind Stitch Machine Mfg. Co., New York.

Dairy

Small automatic rotary filler and capper, Fort Wayne Dairy Equipment Co., Fort Wayne, Ind.
Aluminum foil hood capping machine, Aluminum Seal Co., New Kensington, Pa.
*Large-capacity milk cooler, York Ice Machinery Corp., York, Pa.

Domestic

Apartment size washer, Holland-Rieger Corp., Sandusky, O.
Remote control kitchen fan, Autovent Fan & Blower Co., Chicago.
Vacuum cleaner, General Electric Co., Bridgeport, Conn.
Automatic toaster, National Stamping & Electric Co., Chicago.
Oil heater with electric heat driver, Florence Stove Co., Gardner, Mass.
Roof fans, Truflo Fan Co., Harmony, Pa.
Automatic bin-feed stoker, Link Belt Co., Stoker Div., Chicago.
Rotary type electric ironer, General Electric Co., Bridgeport, Conn.
Window fan, Chelsea Fan & Blower Co. Inc., New York.
Mixer, A. F. Dormeyer Mfg. Co., Chicago.

*Illustrated in pictorial center spread, Pages 58-59.

Flour Mill

Bag sewing machine, Union Special Machine Co., Chicago.
*Sifter, Richmond Mfg. Co., Lockport, N. Y.

Laundry

*Industrial washing machine, Ross Industries Corp., New Brunswick, N. J.

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Overhead handling system, Cleveland Crane & Engineering Co., Wickliffe, O.
Hydraulic die lifter, West Bend Equipment Co., West Bend, Wis.
Electric hoist, Detroit Hoist & Machine Co., Detroit.
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Double-geared steel side trimming press, Chambersburg Engrg. Co., Chambersburg, Pa.
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Crankpin grinder, Goetz-Voss Corp., Wauwatosa, Wis.
Cylindrical grinder, Farrel-Birmingham Co. Inc., Ansonia, Conn.
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*High-speed hydraulic fixture punches, Progressive Welder Co., Detroit.
*Vertical milling machine, Kearney & Trecker Co., Milwaukee.
*Gear finishing machine, Gear Processing Inc., Cleveland.

Office

*Duplicator, Heyer Duplicator Co. Inc., Chicago.

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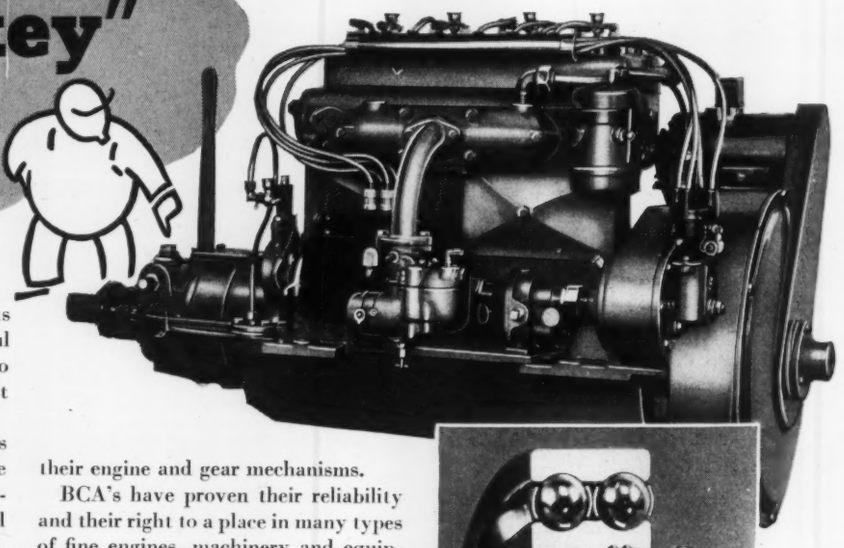
Side seam stitching machine, Harris-Seybold-Potter Co., Cleveland.
Pliofilm hood sealing machine, The Creamery Package Mfg. Co., Chicago.
Bottom stitcher, Ideal Stitcher & Mfg. Co., Racine, Wis.
*Electric label paster, Scientific Filter Co., New York.

"Big Huskey" in here, too



PALMER BROS. LLH is all that its name "Big Huskey" implies. Powerful and rugged, as an engine must be to stand up in typical service, yet it must run as smoothly as a fine watch.

That is where BCA Ball Bearings come into the picture—and go into the reverse gear of "Big Huskey". The particular type of bearing used in this model is the double row annular illustrated, but Palmer Bros. Engines, Inc., rely on BCA single and double row ball bearings for a variety of applications in their engine and gear mechanisms.

BCA's have proven their reliability and their right to a place in many types of fine engines, machinery and equipment. When you buy ball bearings, talk to BCA. BEARINGS COMPANY OF AMERICA, LANCASTER, PENNA.

BCA RADIAL • ANGULAR CONTACT • THRUST BALL BEARINGS

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10 to 64 D.P.

High Precision
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A few pieces
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As you want them—
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For fractional H.P. applications of all kinds. Speed reducing gears in the smaller range . . . *Special* facilities for GRINDING and POLISHING worm and screw threads before or after hardening.

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CHICAGO

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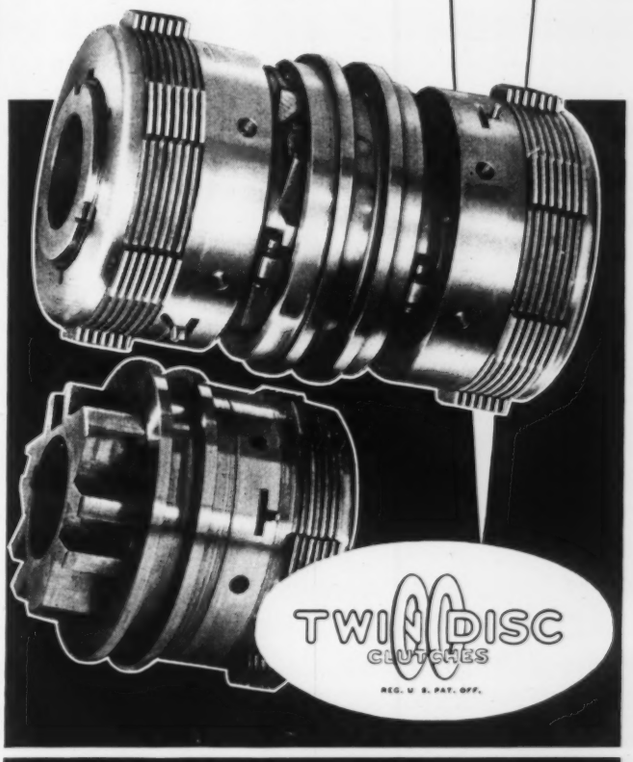
BELOW: *Twin Disc Model MT duplex machine tool clutch.* AT BOTTOM: *Twin Disc Model MT single machine tool clutch.*



TWIN DISC CLUTCH COMPANY • 1325 RACINE ST., RACINE, WIS.